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THE PERCEPTION OF ERROR

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I. INTRODUCTION

What happens perceptually when a complex stimulus field contains a part that violates a well-established expectancy? To what extent does the presence of an error or an incongruity affect the speed and efficiency with which perceptual organization develops? Does violation of an expectancy have different effects with relatively familiar and unfamilar stimuli? This paper attempts to provide some experimental answers to these questions, and to examine the results in terms of general perceptual theory.

II. PERCEPTUAL HYPOTHESES

In any given situation, the organism is not equally prepared for any or all types of objects, or sequences of objects. Rather, the organism is selectively 'set' for a limited range of events and has more or less definite expectations about the characteristics of these events. We shall refer to these expectations, based on past commerce with the environment, as *hypotheses* (8, 10). Hypotheses, then, are predispositions of the organism which serve to select, organize, and transform the information that comes from environmental stimulation.

We may regard environmental stimuli as patterns of information which serve to arouse, confirm, and deny the organism's hypotheses. In any given situation, there may be more or less information present that is relevant to the arousal and confirmation of a given type of hypothesis. For example, a hazy bluish colour or converging lines are patterns of information relevant to the arousal and confirmation of hypotheses about distance. Temperature stimuli, on the other hand, would have little relevance to such an hypothesis. In general, all stimulus characteristics constitute *relevant information* which help to discriminate those features of the environment to which the hypothesis refers.

Stimulus information serves to confirm or deny hypotheses. If the incoming stimulus information 'matches' the expectancy or confirms the hypothesis, a stable perceptual organization results, an organization which will be typically accompanied by a report of subjective certainty on the part of the subject. If the incoming stimulus information fails to confirm the hypothesis, the hypothesis may shift and continue to shift until confirmation has taken place. The relation between hypothesis and information is analytically conceived as cyclical, with a continuous process of trial-and-check (11) of hypothesis against information until confirmation has resulted in stable perceptual organization.

The influence of hypotheses on perceptual organization and the process of perceptual trial-and-check should be especially evident in situations in which a well-established

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hypothesis is violated by environmental events. The difficulty of recognizing the unexpected as compared with the expected allows us to gauge the strength and persistence of the hypothesis in the face of contradictory stimulus information. The stages of perceptual reorganization, from rejection of a well-established hypothesis to final recognition of the unexpected, throw light on the processes of perceptual trial-and-check and perceptual relearning.

III. Determinants of hypothesis strength

Hypotheses vary in strength. The stronger an hypothesis, the wider is the range of stimulus conditions over which it will continue to influence perceptual organization and the more slowly will an alternative hypothesis be substituted for it if environmental conditions no longer conform to the hypothesis. Operationally, the strength of an hypothesis can be defined in terms of the amount of relevant information necessary to confirm it or deny it. A strong hypothesis will be confirmed by a smaller amount of relevant stimulus information than a weak hypothesis; by the same token, a larger amount of relevant information will be required for denying a strong hypothesis than a weak one.

The determinants of hypothesis strength must be established experimentally. The experiment to be reported in this paper attempts to demonstrate the effectiveness of two determinants of hypothesis strength: (1) frequency of past confirmation, and (2) degree of cognitive support.

The first determinant of hypothesis strength with which we shall concern ourselves is frequency of past confirmation. Other things being equal, the more frequently an hypothesis has been confirmed in the past, the greater is its effective strength, i.e. the smaller amount of relevant stimulus information will be required to confirm it on subsequent occasions. Experimental studies of perceptual learning lend support to our proposition. Under conditions of reduced stimulation, e.g. tachistoscopic exposure or peripheral vision, the more frequently a stimulus constellation has been experienced in the past, the more readily is it recognized, i.e. the smaller amount of relevant stimulus information is required to confirm the subject's hypotheses (2, 4, 6, 9). Our experiment will provide a further test of this proposition.

The second determinant of hypothesis strength, cognitive support, denotes the degree to which a specific hypothesis is supported by a larger cognitive context. The more firmly a given specific hypothesis is embedded in a larger cognitive organization, the greater is its effective strength and the more readily is it confirmed. By the same token, the more firmly a specific hypothesis is embedded in a larger cognitive organization, the more resistant will it be to change.

Perceptual responses to 'incongruities' bear out the importance of cognitive support. 'Incongruities' are stimulus situations in which well-established expectancies, more or less firmly embedded in larger cognitive organizations, are violated. In an experiment by Bruner & Postman (3), for example, the stimuli presented to the subjects for tachistoscopic recognition violated the well-established and frequently confirmed hypothesis concerning suit-colour association for playing cards. Black hearts, red spades, and similar incongruous suit-colour combinations were used. Recognition thresholds for incongruous cards were much higher than for normal ones. Recognition of the incongruity, moreover, was frequently preceded by responses in which deviation from expectancy was either fully or partially rectified. An hypothesis which commands strong cognitive support is discarded slowly.

In the experiment to be reported, we shall use perceptual response to the unexpected or incongruous as a method of gauging the effectiveness of these two determinants of hypothesis strength.

IV. EXPERIMENTAL PROCEDURE

The experiment was designed (1) to provide evidence for frequency of past confirmation and degree of cognitive support as determinants of hypothesis strength, and (2) to explore the specific ways in which variations in these determinants affect perceptual organization.

Part I. The experiment consisted of two parts. In Part I, we adapted a procedure previously described by Aveling (1). The stimulus materials consisted of a line of seven capital letters, all consonants, typed on white cardboard. All the consonants were symmetrical (e.g. W, X, etc.) except for one critical letter, 'F'.

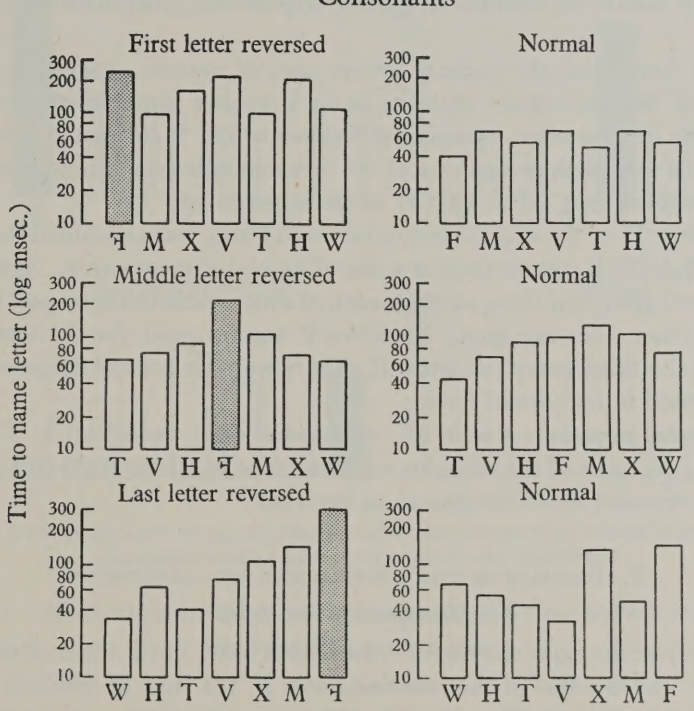

Fig. 1. Average exposure times (log msec.) required for naming of individual consonants under the various experimental conditions.

There were three experimental groups of three subjects each and three control groups, again of three subjects each. For members of the experimental groups the critical letter F was presented *reversed*. The reversed letter appeared at the beginning of the line (first position) for one group; in the middle of the line (fourth position) for the second group; at the end of the line (seventh position) for the third group. To each experimental group, there corresponded a control group which received the line of consonants in exactly the same order, but with the letter F printwise. The stimulus series for the three experimental groups and the three control groups may be seen in Fig. 1.

The subjects were presented the line of consonants for recognition in a mirror tachistoscope. The stimulus card was first presented for 10 msec.; duration of the exposure was

then increased in steps of 10 msec.; until all letters had been correctly recognized. In the case of the experimental subjects, exposures were continued until the reversed F was not only correctly named as an F but also recognized as reversed.

The subjects were in ignorance of the purpose of the experiment which was presented to them as a test of visual acuity. They were instructed to report after each exposure everything they saw or thought they saw.

It may safely be assumed that printwise letters have been experienced by subjects more frequently than reversed letters. There should be, then, a much stronger expectancy or hypothesis that all the letters in a sequence appear printwise than that some appear reversed. If such is indeed the case, the reversed letter should be recognized more slowly than the printwise letter in the corresponding serial position.[1] The presence of the reversed letter in the block of letters may, moreover, be expected to slow down recognition of the adjacent normal letters if failure to confirm a specific hypothesis generalizes to closely related hypotheses.

The reversed letter and the normal letters are, of course, arrayed in an arbitrary sequence. Hence, the expectancy that the letter F appear printwise receives no support by virtue of being in a common, meaningful English word. If such contextual support for the expectancy be provided, recognition of the reversed letter should be slowed down even more. These considerations led to Part II of the experiment.

Part II. In Part II of the experiment, a reversed letter was embedded in a meaningful 7-letter word, PLASTER, rather than in a line of unrelated consonants. Again, there were three experimental groups of three subjects each of which varied with respect to the position of the reversed letter. For one group the letter P was reversed, for the second group the letter S, and for the third group the letter R. There were six control subjects to whom the word was presented in its normal form.

The experimental procedure was in all respects the same as in Part I. For the experimental subjects, exposure of the stimulus was continued until the word had been correctly named and the reversed letter recognized as reversed.

V. Results of the experiment and discussion

(*a*) *Recognition thresholds*

Fig. 1 shows the average exposure time at which each letter in the block of consonants was *named* correctly. In the case of the reversed letter F, the time at which it was correctly named as an F is plotted, *regardless of whether it was also identified as reversed.* The data are presented separately for each of the three experimental groups and their corresponding control groups.[2]

In Fig. 2 the parallel data are plotted for the meaningful word PLASTER. The average exposure time at which each of the individual letters was recognized is shown for each of the three experimental groups and for the control group.

We first compare the average speeds of exposure at which reversed letters and their corresponding control letters were correctly named (Table 1). With such time measures a logarithmic transformation is advisable since the distributions of measures tend to be

[1] This expectation is in accord with Henle's findings that fewer reversed letters than normal letters are reproduced correctly under conditions of reduced stimulation (6).

[2] Since the position of the reversed letter in the line was found to have little systematic effect, we shall discuss combined results obtained for the three positions with little reference to letter position.

skewed. Hence, the average logarithms of exposure times and geometric means of exposure times are presented. Table 1 clearly shows that a reversed letter is recognized more slowly than the same letter printed normally and occupying the same position in an identical block of letters. Such is the case both for the series of disjointed consonants and for a meaningful word. We note that letters in a meaningful word are recognized faster than in a block of consonants but the relation between normal and reversed letters is the same in both cases.

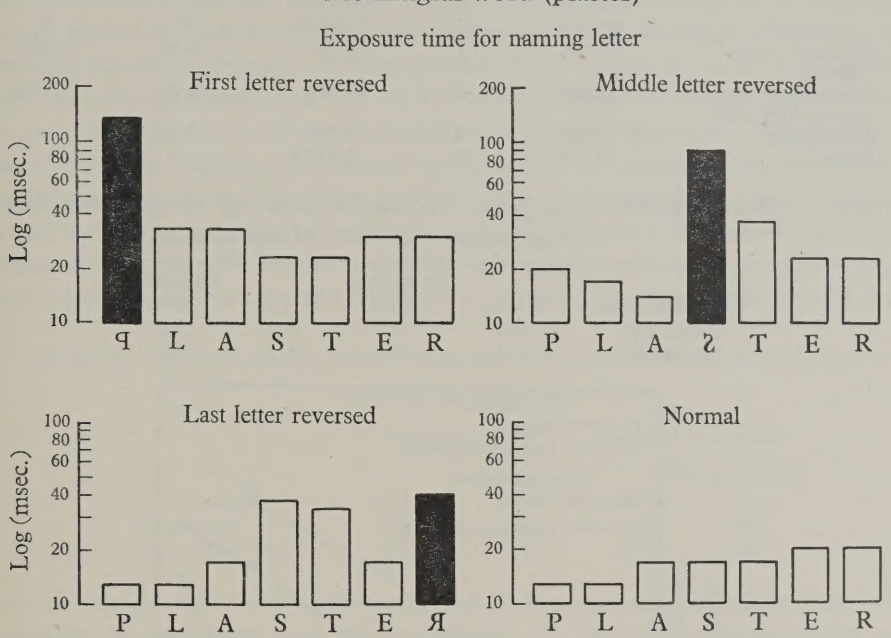

Fig. 2. Average exposure times (log msec.) required for naming of individual letters in the meaningful word under various experimental conditions.

Table 1. *Mean exposure times (msec.) required to name reversed letters and corresponding control letters*

	Reversed letter		Control letter	
Type of stimulus	Av. log	Geometric mean	Av. log	Geometric mean
Consonants	2·39	246	1·87	74
Meaningful word	1·62	42	1·20	16

An analysis of variance was performed to test the significance of these differences. The results of this analysis are summarized in Table 2. This analysis shows that (1) the difference in the recognition times of reversed and normal letters is highly significant, and (2) there is a significant difference between the speeds with which letters in the consonant series and the meaningful word are recognized.

Does the presence of a reversed letter in the stimulus series slow down recognition for *other* letters?

Table 3 shows the average recognition times for all letters *other than the critical letters*, i.e. all letters other than the reversed letters and their corresponding controls. We are here

comparing identical letters in identical positions which differ in only one respect, the presence of a reversed letter in the experimental series as against an unbroken series of printwise letters in the control series. Table 3 shows that the average recognition time for printwise letters in the control series is shorter than for letters in the experimental series, i.e. the presence of a reversed letter slows down efficiency of recognition for *other parts* of

Table 2. *Analysis of variance of recognition times (log msec.) for reversed letters and corresponding control letters*

Source	Sum of squares	D.F.	Mean sum of squares	*F*	*P*
Reversed versus control	13,798	1	13,798	9·74	<0·01
Consonants versus meaningful word	37,231	1	37,231	26·28	<0·01
Interaction	5,320	1	5,320	3·76	—
Error	41,078	29	1,416·4	—	—

Table 3. *Mean exposure times (msec.) required to name all except critical letters*

	Experimental condition		Control condition	
Type of stimulus	Av. log	Geometric mean	Av. log	Geometric mean
Consonants	1·87	74	1·73	54
Meaningful	1·31	20	1·18	15

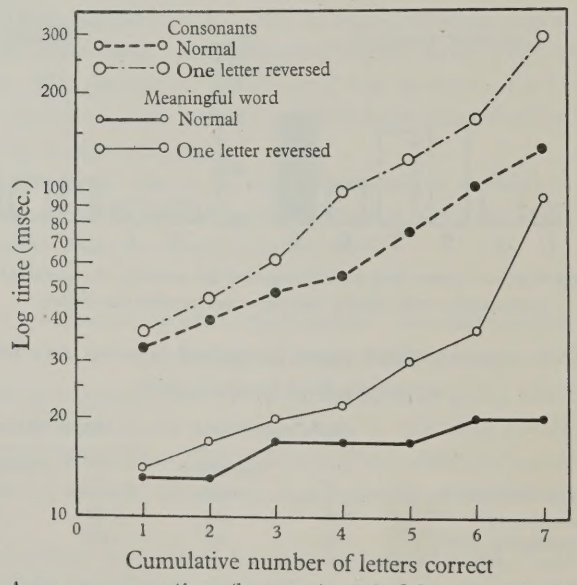

Fig. 3. Average exposure times (log msec.) required for recognition of different numbers of letters under the various experimental conditions.

the stimulus. This difference is highly significant ($t = 13{\cdot}2$, $P = < 0{\cdot}001$). The failure t confirm a specific hypothesis thus weakens related hypotheses and leads to a genera decrease in perceptual efficiency.

Fig. 3 shows the same facts in a different way. In this figure, the average exposur times required for recognition of different total numbers of letters are plotted. The exper mental groups are slower than the control groups throughout the entire duration of th experiment. For any given cumulative number of correct letters, the average recognitio

time of the experimental subjects lies above that of the controls. Recognition of the *total* seven-letter stimulus (including the reversed letter) is, of course, considerably slower for the experimental groups than for the control groups.

The high recognition thresholds for reversed letters bear out the view that frequency of past confirmation is an important determinant of hypothesis strength. The hypothesis that letters appear printwise has been confirmed much more frequently in the past than the hypothesis that they appear reversed. The hypothesis of printwise letters is, therefore, more readily aroused and more easily confirmed in the presence of reduced stimulation. Hence, the normal letters are named at faster exposure speeds than the reversed ones.

The rôle played by cognitive support is illustrated by the thresholds for recognition of the reversed letters *as reversed*. It was possible for a subject to name a reversed letter correctly as an F (consonants) or a P, R, or S (PLASTER) without recognizing it as reversed. Such a response may be classified as a rectification or assimilation to a strong hypothesis. Partial information confirms the strong hypothesis of the presence of a *printwise* letter. Our arguments concerning cognitive support as a determinant of hypothesis strength would lead us to expect such rectifications to be more frequent in the case of the meaningful word than in the case of the consonants. The meaningful context, we would argue, adds stronger cognitive support to the hypothesis. Hence, the hypothesis should be more

Table 4. *Average time at which reversible letter was named correctly and reported as reversed*

	Named correctly		Reported as reversed	
Condition	Av. log	Geometric mean	Av. log	Geometric mean
Consonants	2·39	246	2·22	166
Meaningful word	1·62	42	2·29	193

resistant to change and tend to be confirmed in the presence of information which is only partially in agreement with the hypothesis. In Table 4 we compare the average times required to identify the reversed letter, i.e. to name it correctly, and the average time required to perceive the presence of a reversal. In the case of unrelated consonants, the presence of a reversal is, on the average, reported *before* the reversed letter is correctly named. In the case of the meaningful word, however, the presence of the reversal is usually reported *after* the reversed letter has been correctly named. The two distributions of differences between the times at which the reversed letter was named correctly and the times at which it was reported as reversed show virtually no overlap ($t = 3{\cdot}27$, $P = < 0{\cdot}01$). If a reversed letter appears in the context of a meaningful word, the hypothesis that it is printwise has strong cognitive support and is resistant to change.

(*b*) *Analysis of pre-recognition responses*

We have analytically described the perceptual process as a cycle of attempted hypothesis confirmations. Considerable light can be cast on the characteristics of this cyclical process, if such it be, and the mode of operation of hypotheses by careful description of the nature and sequence of the subject's responses to the stimuli prior to complete correct recognition. We shall describe pre-recognition responses made specifically to the reversed letter as well as systematic response tendencies to the total stimulus pattern. In view of the small number of subjects, we shall not attempt to quantify the frequency with which

the various types of pre-recognition responses appeared but limit ourselves to qualitative descriptions.

Let us consider pre-recognition responses to the reversed letter first. The powerful effect of the hypothesis that letters would appear printwise rather than reversed is demonstrated by the frequent and varied rectifications of the reversal in the direction of expectancy. On a large proportion of trials, the reversed letter is reported as facing forward. Thus, the reversed F in the line of consonants is reported not only as a forward F, but also as a forward P, E, T, I, or L as well as a lower-case 'q'. This last response is an especially good illustration of the persistence of the hypothesis that the letters appear printwise. The hypothesis of a printwise lower-case letter embedded in a series of capitals appears to have greater strength and is aroused more readily than the hypothesis of a reversal. Rectification of the reversed letter was even more frequent in the case of the meangingful word, PLASTER. In some cases, of course, a subject reporting a reversed P, S, or R as printwise may not have been responding to that letter specifically but may have inferred it from the meaning context in which it appeared. That such was by no means always the case is shown by the fact that the reversed letter was frequently rectified prior to recognition of the meaning of the word. Thus, the reversed P was reported as a forward T, G, and again, lower case 'q'. Reversed S was reported as forward K, E, B, R; reversed R, as E and A.

The most striking evidence for the directive influence of a strong hypothesis comes from the disorganization of the perceptual field which frequently results when the hypothesis fails to be confirmed. A few sample protocols will illustrate the phenomenon. Faced with a backward F, and after several unsuccessful attempts at rectification, subjects give reports such as these:

Subject BR

Trial 16. I do not think that first letter is a letter.

Trial 19. My guess is it was an F but different print from other letters. A curlicue is in front. It might not be a letter at all.

Trial 20. My guess is that it is either a T or not a letter.

Subject HA

Trial 13. The one right next to the H does not look like anything at all. It looks like an S with a line through it.

Trial 14. That one after the H still looks crazy.

A few sample protocols for the meaningful word follow:

Subject MU

Trial 5. First letter is kind of awkward...inverted L or something, maybe a C and sometimes it looks like a backwards letter.

Trial 6. A backward P is at the beginning.

Trial 7. Looked like a G that time.

Trial 9. I'll stick with GLASTER.

Trial 11. That first letter is not really too clear. Not sure whether it is a G or small g, maybe small p or q.

Subject PE

Trial 16. Not sure whether R or H, but I would say 'plaster'.

Trial 17. Looked completely different. The R looked backwards. The word did not look like 'plaster'. After comment: You know, sometimes that R seemed to be going one way and sometimes the other.

Needless to say, no comparable reports were ever obtained from the control subjects. Nor did all our experimental subjects show such disorganization of their perceptual performance. Clearly, subjects vary in their ability to abandon a well-established, fre-

quently confirmed hypothesis and to shift to a new hypothesis. As the studies of Frenkel-Brunswik (5) and Klein and her associates (7) have shown, the ability to shift hypotheses, which Frenkel-Brunswik calls tolerance for ambiguity, may be deeply rooted in personality characteristics.

Reversal of a letter not only influenced recognition of that letter but spread to other parts of the stimulus field as well. Perhaps the most striking example of such 'irradiation' of effects is reversal of the total stimulus field. Our findings here confirm those reported earlier by Aveling (1). Several of the experimental subjects reported, on repeated occasions, that the *whole field* seemed reversed or backwards. Of the three subjects for whom the reversed letter appeared at the beginning of the line of consonants, two reported the effect. Samples from their protocols follow:

Subject IU

Trial 3. That time I seemed to have a tendency to read from right to left.
Trial 14. I have such a tendency to see it backwards. I don't know why.

Subject OR

Trial 5. Looked like typewritten writing. Looked almost as though it might be backwards, though I could not read it.
Trial 8. A whole word spelled backwards.
Trial 11. WH at right extremity, still backwards.

With a reversed letter in the middle of the series, one subject reported reversal of the total field. No such reports were obtained when the reversed letter was at the end of the series. Reports of total reversal of the field were never given for the meaningful word.

There were other irradiation effects. On occasion, subjects reported that the total field was upside down or somersaulted. Again, on other occasions, subjects would show a tendency to report letters reading from right to left rather than left to right. These effects once more are limited to reports on the consonant series; they were never obtained with the meaningful word.

Such irradiation effects illustrate the interdependence of hypotheses concerning parts of the field and the whole field. Once the hypothesis of reversal is aroused, it may generalize to the total field. Note, however, that total reversal and related effects are never reported for the meaningful word. The meaningful context lends sufficient cognitive support to the hypothesis that all, or the majority of, letters are printwise to render it resistant to change. The stronger the hypothesis concerning the whole configuration, the less likely is it that a contradictory hypothesis concerning part of the field will generalize to the whole. Rather, the hypothesis about the whole will continue to determine hypotheses about parts.

Our findings are closely akin to the Gestalt principle that properties of a substructure are largely determined by the properties of the larger whole or structure in which it is embedded. Analysis in terms of systems of hypotheses is in no sense intended as a contradiction of this principle. The patterning of hypotheses may well obey configurational principles. Some hypotheses are more readily confirmed and more resistant to change by virtue of their membership in well organized cognitive structures. In terms of our analysis, however, the concept of hypothesis is the more generic one. Laws of organization are determinants of hypothesis strength interacting with other determinants such as frequency of past confirmation of the hypothesis.

VI. Summary and conclusions

In this experiment, we have demonstrated the effectiveness of two variables as determinants of hypothesis strength: frequency of past confirmation and cognitive support. Frequency of past confirmation was varied by comparing recognition of normal printwise letters with recognition of reversed letters. Cognitive support was varied by embedding the reversed letter in a series of unrelated consonants and in a meaningful word. The effectiveness of the two determinants is illustrated by the following results:

(1) Reversed letters, over all conditions of the experiment, are named correctly at slower exposure times than printwise letters. The hypothesis that letters are printwise has been confirmed more often than the hypothesis that they are reversed. Hence, less of relevant stimulus information is required to arouse and confirm such an hypothesis. Typically, there is rectification in accordance with expectancy before recognition of the reversal occurs.

(2) Presence of a reversed letter slows down recognition of other parts of the field. Failure to confirm an hypothesis frequently confirmed in the past leads to a decrease in perceptual efficiency.

(3) The perception of a reversed letter *as reversed* occurs relatively more slowly in the context of a meaningful word than with a disjointed series of consonants. Meaningful hypotheses command greater cognitive support than do hypotheses concerning an unorganized pattern and make it more difficult for an incongruity to be perceived.

(4) Presence of a reversed letter frequently causes phenomenal changes in the total stimulus field, e.g. reversal of the total series of letters. This fact illustrates the generalization of hypotheses from a part of the stimulus pattern to the whole. Again, the meaningful word is more resistant to such irradiation effects than is an unorganized pattern.

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THE RÔLE OF DEPTH OF FOCUS IN DEPTH PERCEPTION

By EDGAR HOWARTH

I. *Introduction* (p. 11). II. *Description of apparatus used* (pp. 11–12). III. *Method of investigation* (pp. 12–13). IV. *The complete procedure* (pp. 14–15). V. *Distance discrimination results* (pp. 15–16). VI. *Visual acuity results* (p p.16–17). VII. *The rôle of depth of focus* (pp. 17–18). VIII. *Correlations between visual acuity and depth perception* (pp. 18–19). IX. *Final discussion* (p. 19). X. *Summary* (p. 19). *References* (p. 20).

I. Introduction

The perception of space has proved of interest to many philosophers and psychologists and, while the former were mainly concerned with deciding whether the capacity for space perception was inborn or acquired, the latter were more concerned with the examination of cues and the psychophysical measurement of distance discrimination thresholds. Our present investigation belongs in the latter category and is intended to fill a gap in the knowledge of both cues and thresholds. Having observed that the illumination level was seldom specified in previous work in this field, we determined to try to answer three questions. First, how does variation in field illumination affect the acuity of distance discrimination? Secondly, does rising illumination improve depth perception, as might be expected, by increasing visual acuity and heightening brightness discrimination? Thirdly, how are visual acuity (v.a.) and acuity of depth perception (d.p.) connected?

II. Description of apparatus used

Our 'artificial construct' had to include: some means of satisfactorily measuring the observer's acuity of distance discrimination; some means of directing and limiting the observer's attention to the point of judgement; a method of conveniently adjusting the field illumination.

The apparatus finally chosen was a careful compromise between some previously used judgement situations—Wundt's thread, Hillebrand's straight edge, Helmholtz's three needles(8) and Bourdon's bright spot(2). It was designed to combine their respective merits while eliminating, to some extent, their defects, being easy to focus on, having no shadow or relief (except for the deliberately introduced striations—see p. 12 below) and being viewed from a constant head position.

The apparatus (Fig. 1) consisted of three rectangular objects, the central one of which (A) was movable along the flanged rail F while the side objects (S) were fixed at a standard distance from O, the observer, who viewed the objects through the rectangular reduction tube T. The scale K and the field background B complete the description of this part of the apparatus. The field illumination was provided by means of the 150 W. lamp L whose flux was varied by adjusting the six-stop resistance R, placed between the lamp and the mains supply M.

Some dimensions of the apparatus were: tube length 94 cm.; field of vision 12 cm. vertically and 18 cm. horizontally; lamp distant 55 cm. from the side objects; side objects distant 160 cm. from the observer's position; objects 2·54 cm. wide with intervening gaps of 2 cm.

Stray shadows were carefully eliminated and all surfaces were non-reflecting, excepting the rectangular objects. The light source L provided a practically parallel beam of light and was at such an angle that no vertical light gradation was perceptible on the object surfaces. The six-stop resistance provided six levels of illumination which were accurately

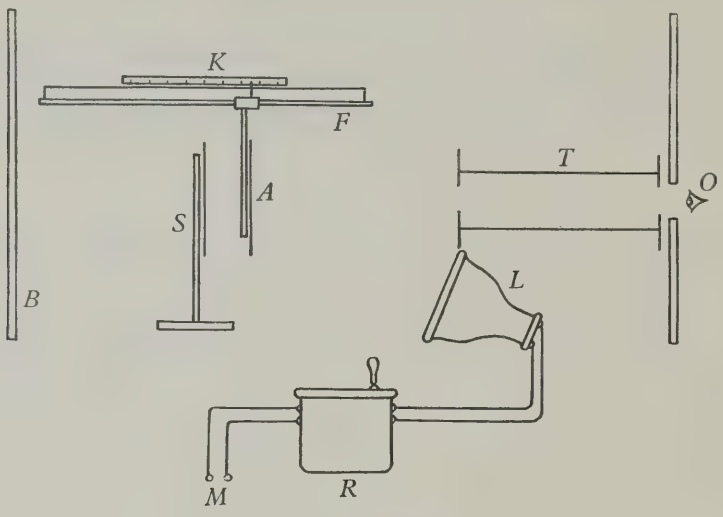

Fig. 1. The apparatus

measured by means of a selenium filter-corrected photo-electric cell registering in micro amperes which were equivalent to foot-candles over the scale range used. The followin readings were obtained with the P.E.C. clamped level with the side objects facing L:

Resistance position	W6	W5	W4	W3	W2	W1
P.E.C. reading	36	33	27	16	7·5	3

The cues for distance discrimination were provided by: (*a*) brightness differences betwee A and the two side objects S; (*b*) size differences; (*c*) focusing (crossed and uncrosse images); (*d*) in addition, fine horizontal striations were drawn in black across the mat white object surfaces, in order to provide definite visual acuity cues. Other surfac markings were tried but this type proved the most effective for the purpose.

The scale used in these binocular experiments consisted of four $\frac{1}{2}$ cm. intervals on eac side of the standard. It was 4 cm. in total length. A much larger scale is, of cours necessary for monocular work.

III. Method of investigation

Both distance discrimination thresholds and visual acuity were measured as, in additic to comparing a single observer's D.P. acuity in the six levels of illumination, we wished t examine the extent and nature of rank correlations between visual acuity and D.P. pe formances of the several observers. (Hereafter we will refer to the acuity of distance di crimination as, simply, D.P.; and to the visual acuity or resolving power, as V.A., in ord to avoid confusion.) In the main investigation we also decided to test a good number subjects as, in a difficult judgement situation, random fluctuation may occur and m disguise any trends present in a single curve.

General Method. In general the method is one of statistical comparison of limens: first, between the observer's own judgements in the different conditions of illumination; secondly, between different observers.

After numerous practical trials the psychophysical method of limits proved to be most convenient. The method is well described by Guilford (4) and was used in the way he indicates. At each level of illumination the observer's D.P. was determined by ten estimations of his upper and lower limens, using alternately ascending and descending series, beginning at large, medium or small distances from the standard. The order of presentation was purely arbitrary except for allowing for four 'large'; three 'medium' and three 'small' series to be presented for the usual reasons.

The size of the steps through which the central object was moved was a compromise between larger steps, meaning more easily discernible differences, and smaller steps which would have been less easily detected. The latter would have led to an increase in the random variability of the results which would also have served to disguise trends. The number of steps in the scale was also arbitrary, but four on either side of the standard were finally used. An 'ascending' series was one moving away from the observer and was recorded as starting negative, whereas a 'descending' series was with *A* moving towards the observer and was recorded as positive, moving through 'equals' to negative (if required) in each case.

Choice of observers. Twelve observers were used. They were young (20–30), of both sexes (no sex difference observed) and in respect of their eyesight they were chosen at random. No attempt was made to reject subjects with visual defects but those normally wearing corrective lenses were asked to use these in the experiment.

Conditions. A dark room with no windows, grey walls, and lit by a ceiling holder giving an illumination midway in the levels used, formed the main surroundings external to the apparatus.

In order to control possible factors of hourly perceptual efficiency, all the experiments were performed just before, during, or after, the lunch interval, thus ensuring mid-day optical conditions.

In case knowledge of results should affect performance, no subjects were told any details of the experiment, except those contained in the instructions below. That is, they were not told how many illumination levels would be used, how long their judgements might be expected to last, how many series there were at each level, or in what order to expect the illuminations to be presented.

Instructions to observers

Your binocular depth perception acuity and visual acuity will be measured.

The first measurements will be of your visual acuity using the horizontal lines drawn across the vertical white objects seen through the tube. The experimenter will move the central object away and towards you. At each stage judge whether the lines are clearly separable or blurred.

The second measurements will be of your depth perception using the three objects. The central one will be moved in alternating series towards and away from you. Judge NEARER, FURTHER, or EQUAL. Look with both eyes but close your eyes or look away directly after each judgement when the central object will be moved.

Finally your visual acuity will be measured again using the same criterion—clarity of lines on the objects.

IV. The complete procedure

Let us now, for clarity, consider the complete procedure from the observer's entering the experimental situation to the calculation of the results. After entering the room, *O* was asked to read the instructions, thus ensuring a period of adaptation which served to equate the degree of pre-experimental adaptation of *O*'s.

Visual acuity measurements. The fine horizontal striations were purposely not drawn at equal vertical intervals and patches of blurring occurred where the lines grouped closest at $\frac{1}{2}$ mm. intervals. This meant that the lines began to blur differentially as the central rectangle was moved further away from *O* and it was possible to determine in each case the distance from *O* at which the lines were last clear to within 1%. These have been called 'blur points'.

Note that a transparent scale was used to measure the longer travel needed for the V.A. measurements. This proved more convenient to use than a pilot light or luminous scale which would also have served for readings in the lower levels of illumination. Our measurements are comparative rather than absolute, but this scale was equivalent to centimetres as follows:

R.A.F. navigational scale:	0	40	80	120	160
Centimetres from observer:	134	147	160	172	185

That is, ten units on this scale were slightly over 3 cm. and it was possible to calculate where the 6/6 Snellen value occurred. With vertical distances such as were used here, this occurred at about 120 on the R.A.F. scale or at about 172 cm. from the observer's position. (This occurs on the lower parts of the curves in Fig. 5.)

We can thus roughly measure V.A. in the D.P. situation and also, and this is more important, we can then compare the relative V.A.'s of our observers with their D.P. performances. Movements of the test object are not usually to be recommended, but rather than use lenses and aerial images Hartridge (5) states that for a constancy of 1% in the true scale of the test object any distance between 1·7 m. and infinity may be used.

Visual acuity was measured in all six levels of illumination with the order of presentation W6, W4, W2, W5, W3, W1. This was used to prevent any forward-going adaptatory effects and as a check, for the readings should interleave to give the normal improvement of V.A. with rising illumination (see Figs. 4 and 5). Measurements of V.A. were made both before and after the D.P. test for reasons which will be apparent later.

Depth perception measurements. After the first V.A. measurements the observer was rested for 2 min. in the general room illumination and then the D.P. measurements were commenced. Illuminations were presented in the order W6, W4, W2, W5, W3, W1 to six of the observers and the reverse W1, W3, W5, W2, W4, W6 to the other six observers. Six levels were used, instead of, say, one high and one low, in order to search for trends. The 'zigzag' order of presentation was to offset adaptatory or any possible fatigue or transfer effects. It is possible to make quite complicated calculations which, however, we have not included in this paper, as to the presence of a 'practice effect' or a 'fatigue effect'. It is sufficient to say here that the procedure used minimized either increment or decrement from these sources and, in any case, there were individual differences which need discussion elsewhere.

Between the psychophysical D.P. measurement unit in each level of illumination the observers were rested for 2 min. in the room light and were questioned as to cues used.

comparative levels of difficulty experienced in the various illuminations, after-images, feelings of fatigue and general attitude to the procedure.

Calculation of the results. After completion of the measurements the limens were obtained in the usual way and the average P.S.E. for each unit of ten series was subtracted from the standard to give the constant error. Graphs of D.P. accuracy in terms of C.E.'s

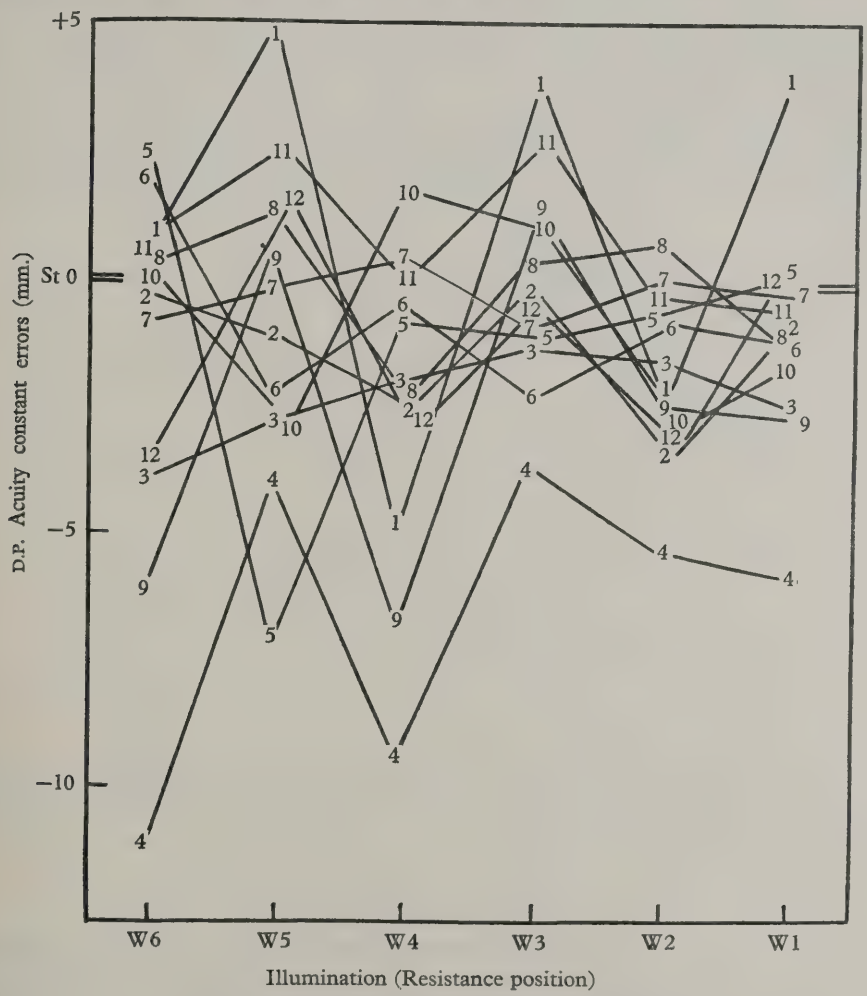

Fig. 2. Depth perception accuracy and illumination

were then constructed for the twelve observers (Fig. 2) and a histogram of C.E.'s was constructed (Fig. 3). Further statistical treatment consisted of calculating the S.D., S.E. and S.E.^{2} for each unit in order to determine the significance level between the points.

V. DISTANCE DISCRIMINATION RESULTS

Fig. 2 shows the constant errors, expressed in millimetres from the standard, along the vertical ordinate, and shows illumination levels along the horizontal ordinate. Each point in the figure is obtained from the psychophysical unit of ten series (five ascending and five descending) and is numbered according to the individual. For example, observer 4 has

poor D.P. acuity (accuracy) and has a consistent tendency to err negatively (towards himself) relative to the standard. The points are joined by unsmoothed curves and it was found, in general, that if their vertical distance apart is greater than 8 mm., the difference between them is statistically significant. However, it is important to point out that the tendency of this individual to err consistently on one side of the standard leads to differences which are insignificant by this criterion, whereas if, as it were, by chance, he jumped randomly on either side of the standard, then 'significance' might be produced. We are looking for trends, however, and, on inspection of Fig. 2, we are lead to the inescapable, and surprising, conclusion *that the lower illumination levels are producing the most accurate depth perception*. This unexpected result will be explained below but, before doing this, we must examine the general distribution of constant errors and the percentage D.P. acuity.

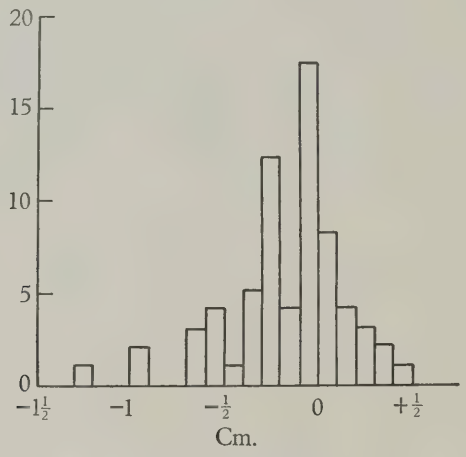

Fig. 3. Histogram of constant errors

Fig. 3 shows the histogram obtained from all the results and indicates a general leve of D.P. acuity of about 0·08% which may be compared with Helmholtz's 0·03%—hi needles offered a shading cue.

VI. Visual acuity results

The individual 'blur points' for the twelve observers are shown, joined by unsmoothe curves, in Fig. 4. Obviously the general trend is for higher V.A. in the higher illuminatio levels. The larger the R.A.F. scale number the further away from *O* the 'blur point occurred, i.e. clarity was maintained at a greater distance.

The question immediately arises as to why we have found a D.P. result which has take place despite this obvious improvement of V.A. with rising illumination. We found similar D.P. result in monocular experiments and had added the striations to the objec in order to ensure the presence of V.A. in the field situation, but D.P. has been found to b more accurate in the lower illuminations despite this precaution. We have examined th experiment, procedure, and apparatus most carefully but, in the absence of any apparen misconceptions, cannot explain the D.P. result in terms of chance artefacts or overlooke controls.

An explanation could be put forward in terms of glare and compensation, i.e. that th

former caused D.P. to be low in the high illuminations and the latter caused D.P. to be high in the low illuminations, but Dorley (3) has shown that compensation—overcoming difficult perceptual conditions by greater effort—may occur in glaring conditions. In addition, we found no evidence from the observers remarks that they tried harder in the lower illumination levels. In fact, we found that accuracy in this situation was not noticeably

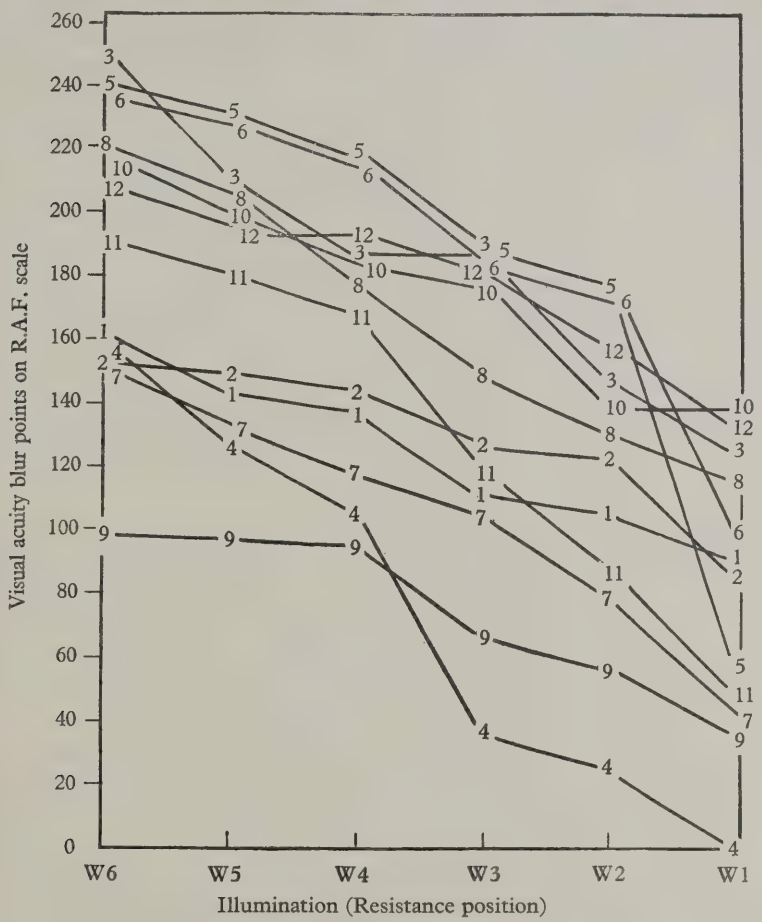

Fig. 4. Visual acuity of individuals compared

susceptible to greater effort, for this often produced less, rather than greater, accuracy, due to a number of factors, including after-images and fatigue. The two curves in Fig. 5 show the slight, but clear, decrement produced in V.A. by the intervening D.P. task. In passing, we may note that the shape of these curves may indicate a scotopic-photopic plateau which is normally undetected and, indeed, the simple S shape of Shlaer's curve (7) may be in need of revision to a double S-shaped curve.

VII. THE RÔLE OF DEPTH OF FOCUS

We believe that a possible explanation of our results lies in the factor of depth of focus, for in the higher illuminations, as is well known, the aperture of the pupil narrows. This increases the definition (Shlaer (7) has found that below 2·33 mm. the pupil aperture,

rather than the cone dimensions, is the limiting factor in resolution), and also the depth of focus by narrowing the incoming ray-pencils. These facts do not seem to have been applied to the study of distance discrimination.

In our present experiment, in the high illuminations, the central object may thus be moved a relatively large distance while still being retained in focus with the side objects. In the lower illuminations, on the other hand, the central rectangle quickly moves out of focus with the side rectangles and the distance differences are more easily discriminable, despite the lowered V.A. The factor of depth of focus may thus, in certain cases, possibly act in opposition to V.A. and be prepotent over it.

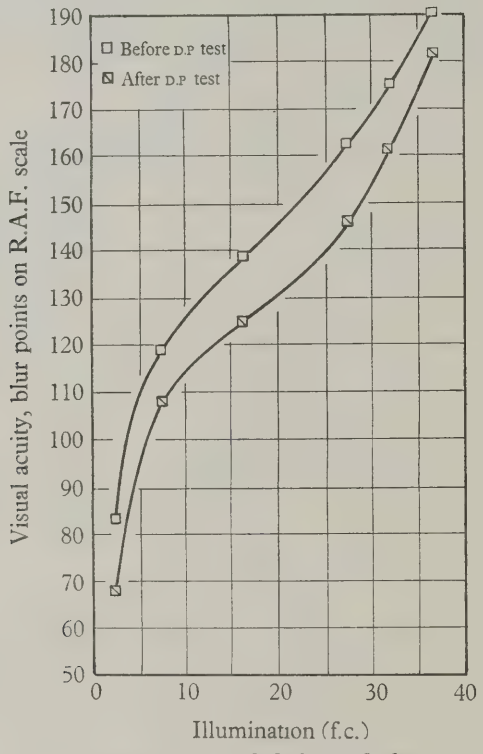

Fig. 5. Average V.A. measurements made before and after D.P. measurements

VIII. Correlations between visual acuity and depth perception

Rank correlations (Spearman) may be calculated between the relative performances of the twelve observers on both the V.A. and the D.P. tasks. The V.A. results obtained before the D.P. measurements (those shown graphically in Fig. 5) were used for this purpose. The correlations were as follows:

Illumination level	W6	W5	W4	W3	W2	W1
Rank correlation	+0·077	+0·068	+0·64	+0·302	+0·409	−0·215

All, except W1, are positive and, as might be expected from the theory that V.A. and depth of focus are most opposed in the extremes used here, the correlations are largest in the central illumination levels and smallest at the extremes. The negative W1 correlation may be due to the very close grouping of ten out of the twelve observers in the W1 D.P

result (Fig. 2) and to the sudden descent of the observers 5 and 6 in the V.A. W1 result (Fig. 4). Obviously with close groupings the relative positions tend to be less stable as random fluctuation may then, more easily, cause the curves to interweave.

The above correlations may be compared with the +0·73 obtained by Hirsch & Weymouth (6) but they obtained this under a variety of conditions and longer distances than those used here. It is likely that the factor of depth of focus counts for less at greater distances, and further research is obviously necessary to determine the relations of visual acuity and depth perception under a variety of conditions. These investigators suggested that 'both visual acuity and distance discrimination seem to rest on the same visual capacity, namely, the form sense, and probably specifically, on brightness discrimination'. This seems to be a reasonable conclusion. However, connexions of this sort are rendered difficult by dynamic factors which may act differentially as between visual acuity and depth perception.

IX. FINAL DISCUSSION

The results of this experiment are put forward merely to suggest further research in this field. If further evidence is found to support the conclusion[1] then the realization of the rôle of depth of focus in distance discrimination may have some practical usefulness. For example, in the pre-Hawthorne experiment, engineers found the strange result that, within limits, lowering the illumination level increased output.

X. SUMMARY

An experiment to investigate the effects of varying the field illumination on the acuity of distance discrimination was attempted using three vertical white rectangles, with the central one movable towards and away from the observer who viewed them through a rectangular reduction tube. Twelve observers were tested binocularly and it was found that, contrary to what might have been expected from visual acuity results, the lower illumination levels gave greater acuity of depth perception (smaller constant errors). An explanation in terms of depth of focus was put forward, i.e. that the small depth of focus (due to larger pupil aperture) produced in the lower illumination levels, caused the central movable rectangle to move more easily out of focus with the fixed side rectangles, so that distance differences were, on this count, more easily perceived.

Visual acuities were also measured and the resulting rank correlations between V.A. and D.P. seemed to verify the main result in that they were largest (positively) in the central ranges. Visual acuity was measured both before and after the main depth perception task and slight, but clearly noticeable, decrements in visual acuity were found, due to the intervening optical work involved.

My thanks are due to Prof. D. Katz and Prof. T. H. Pear, to Dr R. W. Pickford and Dr Florence MacNeill, and to Mr A. B. Royse, Mr J. M. Hopkins and Mr C. E. M. Hansel for their interest and generous help.

[1] Since writing the above we have found some confirmation of our results in the recently published findings of Berry, Riggs & Duncan (1).

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THE FITNESS OF SIGNS TO WORDS

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I. *Introduction* (p. 21). II. *Description of the experiment* (pp. 21–22). III. *Results* (pp. 22–30). IV. *Discussion* (pp. 30–31). V. *Summary and conclusions* (pp. 31–32). *References* (p. 32). *Appendix* (p 33).

I. Introduction

In a study already reported elsewhere(2) on the subject of the fitness of certain pictorial signs to words, it was found that there was a surprisingly high and statistically significant agreement of choice by a group of subjects on one of a pair of signs presented in connexion with a single word. The subjects were required to give their reasons for choosing one rather than the other sign as the more appropriate, and showed a considerable diversity of reason for choosing the same sign. The general conclusion from the experiment was that the reasons given were often only *rationalizations* for a more primary and immediate selection similar to that which takes place in the act of recognition. The 'popular' signs seemed to combine certain Gestalt qualities of symmetry and economy of structure with a sufficient contextual meaningfulness. It seemed clear, then, that it was not necessary for any representational or associative connexion to be perceived in order that a sign should be chosen as appropriate, but that more general, formal qualities influenced the choice.

This problem of the nature of the fittingness of signs to words had first been suggested by Bartlett's Picture-writing experiment(1), in which he observed that certain signs appeared to be peculiarly appropriate to the words they accompanied, so that the subject had the 'feeling' of their appropriateness without being able to verbalize it more concretely. It appeared, however, from the previous study mentioned above that the factors involved in this choice of signs might be very complex, and might involve interesting individual differences in mode of apprehension.

It was, therefore, the purpose of the present experiment to attempt some elucidation of the following points:

(1) If a subject is offered a choice of signs which vary from representational to purely formal and more or less 'meaningless', will there be a high consensus of choice of one particular sign or type of sign?

(2) What individual differences are there in the general type of choice and method of choosing?

(3) In general, is there any evidence as to the nature of the 'peculiar' fittingness that Bartlett observed, and what are the chief factors involved in this concept of fittingness?

II. Description of the experiment

After considering the possibilities of a variety of material and means of devising suitable sign-word series, it was decided to make a set of five signs for each of fifty words which were abstract in their normal meaning. Although, as Bartlett pointed out (p. 97), it is not possible to classify signs accurately as either representational or meaningless, associative or formal, owing to the great variety of individual interpretations always

made, an attempt at a rough classification was carried out. Opposite each word, on a white card, five signs were drawn, two or three of which were intended to represent objects or object-situations in some way connected with the word, while the remainder of the set were intended to evoke, by some formal quality of design, more of a general and unverbalizable 'feeling'. Each set of five signs could be arranged approximately in order of their closeness to, or distance from, representational significance, but the order in which the signs were arranged on the cards was randomized. Some of the material is shown in the Appendix, but the signs are shown in order of choice frequency, and not as originally given to the subject. A few of the signs used were 'conventional' symbols. While such material has this obvious disadvantage of being hard to classify in an accurate and objective way, it seemed that, in this way, the nature of the relative fittingness of various kinds of sign could be more easily observed than if the signs showed more extreme differences in type.

No reason was required from the subject to substantiate his choice, and the time taken to make a choice was recorded for each card, in order that individual variations could be observed.

The subjects were of university educational standard, male and female, and had a wide variety of academic background.

The procedure was as follows:

(1) The subject was told: 'I am going to show you a set of cards, each of which has a word on it and five drawings lettered *a*, *b*, *c*, *d* and *e*. I want you to choose which of these drawings you think is the best symbol for the word on the card, and to read out its letter. Do the same for all the cards. I am taking your total time for the experiment, but you can have as long as you like to make your choice for each card, and there is no hurry.'

(2) A stopwatch was used to record the time taken, in seconds, in choosing for each card. It was started when the subject turned up the first card on the pile, and was kept going throughout the experiment until the last choice was made. It was placed so that the experimenter could read off the time between the turning up of the card and the verbally expressed choice of the subject. The order in which the cards were presented to the subjects was randomized.

(3) When the subject had made his choice for each of the fifty cards, he was asked:

(i) Whether he tended to choose consistently according to some principle, or whether he varied in his method and reasons from one card to another.

(ii) How he thought he proceeded to make his choice when looking at the card. (The subject was left to describe in his own words how he proceeded, but it was hoped to find out in each case how immediate and how analytical was the way in which he set about the task. This, clearly, could be in some measure deduced from the response times.)

(iii) Whether he thought some of the symbols were definitely satisfactory as symbols, while others were not.

III. Results

1. *The general distribution of choices*

In all, thirty-four subjects made choices for each of the fifty sets of symbols. Of these thirty-four, twenty-five were timed on a stopwatch in their response to each card, and the remaining nine were timed for the total time they took for the whole experiment.

The conditions of choice were identical for all the subjects, and the distribution of choices will be first examined. Taking the frequency of choice for the most popular symbol on each card, the highest agreement was twenty-three out of thirty-four (68%), the lowest was nine out of thirty-four (26%), and, for fifteen of the cards, the agreement was 50%, or greater. Since there were five figures to choose from in each case, none of which was deliberately arbitrary, it was to be expected that the distribution of choices for each card would not often show a high percentage of agreement upon one out of the five. Only in five cases was a symbol not chosen at all. Table 1 shows the distribution of choices for each of the fifty cards arranged in order of agreement of choice.

In the Appendix are shown the first twenty words of the table, with the popular sign in each case on the left, and the remaining signs arranged in order of preference.

Table 1

Word	Frequency of choice for each sign					Word	Frequency of choice for each sign				
Visionary	23	5	4	1	1	Malevolence	14	6	6	5	3
Abnormal	21	7	4	2	0	Discipline	14	6	6	4	4
Fear	21	5	5	3	0	Dance	13	10	9	1	1
Prejudice	20	4	4	3	3	Diligence	13	9	6	5	1
Luck	19	9	5	1	0	Peace	13	8	8	3	2
Science	19	9	3	2	1	Ambition	13	8	7	5	1
Freedom	19	7	4	3	1	Tradition	13	8	7	4	2
Weariness	19	7	3	3	2	Time	13	8	6	4	3
Madness	19	7	5	2	1	Death	13	8	6	4	3
Unconscious	18	7	6	3	0	Help	12	10	9	2	1
Art	18	7	6	2	1	Crime	12	10	7	3	2
Energy	17	8	5	3	1	Ambiguity	12	10	6	4	2
Evolution	17	8	5	3	1	Protection	12	10	6	4	2
War	17	8	4	4	1	Education	12	9	8	4	1
Harmony	17	7	5	3	2	Tragedy	12	9	7	3	3
Fate	16	9	4	4	1	Romance	12	9	6	4	3
Melancholy	16	8	6	4	0	Law and order	12	9	5	4	4
Vanity	15	12	3	2	2	Anarchy	12	8	6	5	3
Eternity	15	11	5	2	1	Haste	11	9	7	5	2
Stupidity	14	9	8	2	1	Interest	11	9	6	4	4
Crisis	14	8	5	5	2	Truth	11	8	7	6	2
Wisdom	14	8	5	4	3	Life	10	10	7	5	2
Witchcraft	14	8	5	4	3	Thought	10	9	6	5	4
Fertility	14	7	6	5	2	Enthusiasm	9	8	8	5	4
Veneration	14	7	6	5	2	Atheism	9	8	7	6	4

On examination of the sets of symbols from which some of the most popular choices were made, it is clear that no absolute and consistent grounds for popularity can be deduced from the type of symbol chosen. For the word 'visionary', two of the symbols consisted of objects which could suggest some aspect of the word, one being a telescope, the other an open window. These were selected once and five times respectively. The first symbol which was chosen by twenty-three subjects, was not intended to be representational, but rather to suggest, in a fairly abstract way, aspiration, and a vision beyond the attainment of the earth. The fifth symbol was only intended to suggest illumination and was chosen only once, and the third, which was intended to suggest some vaguely arising property or impression, was chosen four times. Thus, only the second and fourth were intended to be objects, while the remaining three were intended to express some more general impression. As was found in the previous experiment (2), almost any figure that is not purely arbitrarily connected with a word may, by some subjects, be likened to some associated object, but it was considered, from the evidence, that it was not always the capacity of the figure to suggest an object that was primary in influencing choice.

For the word 'abnormal', the first symbol, which was chosen twenty-one times, was again not intended to represent any particular object, but rather to suggest, by its characteristics, something freakish and odd. For the word 'fear', the most popular symbol, also chosen twenty-one times, was intended to suggest some dark shape, possibly a cloud, obscuring the sun. But, for the word 'prejudice', the drawing of a horse's head, its eyes obscured by blinkers, was chosen twenty times, while two other symbols intended to suggest a vaguer and more general idea were chosen three times each.

It is obvious that popularity of choice must depend upon the relative fittingness, not only of the popular symbol but of the remaining four symbols with which it is shown. But, apart from this, the fittingness may clearly be of many kinds, a rough classification for which, from these particular sets of symbols, is as follows:

(1) The figure represents an object commonly associated with the word—examples: dove for 'peace', ant for 'diligence', ladder for 'ambition', dunce's cap for 'stupidity', horseshoe for 'luck', key for 'freedom', the torch of learning for 'education'.

Other objects also are parts of a larger total situation, and might stand for that situation, such as a dagger for 'tragedy', a policeman's helmet for 'law and order', a shield for 'protection', gallows for 'crime', monkey for 'evolution', tin-hat for 'war', school-tie for 'tradition', test-tube for 'science', and so on.

The relation between the object and the word may be a purely conventional historical one, as in the case of the dunce's cap or the dove, or an 'inadequate' experiential relationship such as spur for 'haste', loaf of bread for 'life', or policeman's helmet for 'law and order'.

(2) The object, or objects, are involved in, or expressive of, some situation suggestive of the meaning of the word, such as a pilotless boat at sea for 'atheism', flowers drooping their heads for 'weariness', a straight ruler set beneath a curved surface for 'science', a black cloud passing across the sun for 'fear', a hand sowing seeds for 'fertility'.

(3) The figure is more schematic, like the spiral for 'evolution', books arranged in an increasing order of complexity for 'education', the circle for 'eternity', four trees in a row for 'discipline', two straight and parallel lines for 'law and order', three roads, two of which are blocked, for 'prejudice'.

(4) The figure is not intended to suggest any particular object or relation between objects, but, more immediately, an impression or quality, i.e. a perception, such as cannot necessarily be stated in conceptual terms. Such was the popular figure for 'visionary', for 'madness', for 'abnormal', 'harmony', 'crime', 'time' and so on.

(5) The figure is nearly arbitrary; that is, its relationship to the word cannot be formulated either with regard to some object-characteristic or to some feeling-quality or to some schematic representation. Such are the fifth signs for 'harmony', 'science', 'prejudice', and 'vanity'.

Thus, while there are certain symbols which are popularly chosen as the most appropriate, in so far as the nature of their fittingness is concerned, it is clear that, not only is this relative to the other signs with which it is compared, but may vary from a representational and conventional object, such as tin-hat for 'war', or key for 'freedom', to the more abstract forms chosen in connexion with 'abnormal', and 'madness'. There is, therefore, no clear criterion of fittingness of a sign to a verbal setting such as was used here, and it seems rather that the individual differences in the type of choice made are the most noticeable factor in the experiment.

2. *Individual differences in the type of symbol chosen*

Individual subjects showed very marked differences in the type of sign they preferred as symbol for a word. Some chose fairly consistently the common object with which the word was obviously associated, whenever such an obvious connexion appeared, while others tended consistently to avoid the common object and to choose, whenever possible, a sign that was more general and appropriate in a formal, qualitative way. Others were variable in their reactions, tended to be less consistent and to treat each card more on its merits.

While it was not, as we have already pointed out, possible to make a very accurate classification of the signs, the more obvious object-signs, of which there was at least one for each card, are fairly clearly identifiable, and, taking these into consideration in comparing the types of choice made, we can compare the individual records. Counting, therefore, only the choices made for the sixty-six signs that are most obviously representational, the frequency of object-choice for each subject is shown in Table 2.

Table 2

Frequency of object-choice per subject

43	40	38	37	37	36	35	34	34	33
33	32	31	30	30	30	29	28	28	26
26	26	21	19	16	15	14	14	12	12
12	11	8	6	—	—	—	—	—	—

The range of object-choice varies from forty-three out of fifty to only six out of fifty at the other extreme, and, with the frequencies grouped in threes, the distribution of such choices is shown in the graph of Fig. 1.

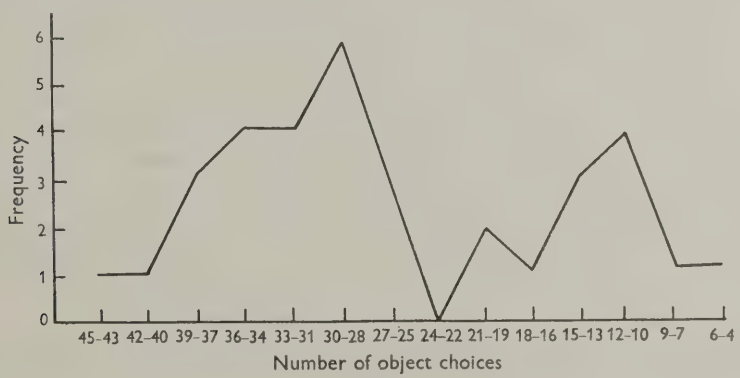

Fig. 1.

Although the numbers involved are small, there is a definite bimodal tendency in the distribution shown. While the majority of subjects (twenty-two out of thirty-four) tend to choose more than 50% object-signs, the remaining twelve show a preference for the non-representational, design-type sign.

A careful comparison of the distribution of choices per card made by the male and female subjects of the group revealed no important sex difference. For one card only, 'vanity', there was a tendency for women to prefer the mirror sign to the bow-tie sign, which was the popular choice with the male subjects.

Subjects' reports

The data of Fig. 1 become clearer if we examine the reports given by some of the subjects after the choice part of the experiment was concluded.

(1) *Forty-three out of fifty object-choices*

This subject said: 'I don't think I had any particular principle in choosing, except that I tended to choose the *obvious* ones mostly. For "law and order" I chose *d* first, thinking of a pair of scales, then I thought that that was more a symbol for "justice", and decided on the policeman's helmet. When considering the abstract ones—(as figure 1 for "harmony")—I think I tried to find some concrete association such as "lines of music"'. (Note. He actually chose the 'accordion' figure for this.) It seemed that, even where this subject chose what have not been classed as 'object' figures, he tended to do so for an associative reason. Of his remaining choices, it seems that all are clearly capable of being named and described in unambiguous and definite terms—for example, the circle for 'eternity', the first figure for 'the unconscious', and for 'weariness'.

With regard to the way in which he made his choice, he said: 'Sometimes, I didn't need to reason—the choice seemed obvious. But mostly I could justify what I chose, at the time. I did argue about them, because I changed my mind occasionally.' As to his general approach to the experiment, he said: 'The fact that I chose the concrete is typical of my whole attitude. For example, I'm good at Latin and Hebrew, but not Greek. Hebrew is a particularly concrete language—it hasn't got any adjectives. I was a bad philosopher, and a good theologian, but not of the speculative type.'

(2) *Six out of fifty object-choices*

The subject at the other extreme of the distribution chose objects for only six of the fifty cards. He said: 'I didn't look for what was the best symbol to convey meaning to someone else. I chose purely subjectively, for example 4 for "peace", whereas the dove is the public one. I did that more or less all through, except when I was stuck—then I chose the best little drawing. I generally chose without object-reference, for the *feeling* the drawing gave me. I went for the movement every time where there was any.' Here, the opposite tendency is quite clear—rather to avoid object-association wherever possible.

The reports of other subjects confirm this attitude in the selection of the appropriate symbol, and some further examples are quoted below, first from the predominantly object-choosers, then from those at the other end of the distribution:

(3) *Those choosing mainly object figures* (the number of object-choices being shown in each case at the beginning of the report).

(i) 40: 'I think mostly I chose the *concrete* ones throughout; for example, for "crime" the gallows is the most obvious, but I felt the black hat was a better symbol. My genera attitude is scientific and concrete, and I didn't find, or look for, meaning in the mor abstract figures—my choices were mostly associative.' This subject tended, on the whole to select the *less* obvious of the concrete symbols, where there was more than one, as o most cards.

(ii) 38: 'I always chose, where possible, a drawing which I could *recognize*. To ever card, there were at least two or three meaningless drawings, and generally two which i was a toss-up which was better.'

(iii) 37: 'Generally speaking, when there was an obvious symbol, I picked that one out, otherwise I tended to use the designs as symbols—in other words, if there weren't any conventional ones, I invented my own.'

(iv) 37: 'I chose the first one that had a recognizable meaning, though always looking at all the figures on the card. I didn't aim at being consistent in the way I chose. When I looked at the figures on the card, I tried always to see what they were meant to be. If I couldn't see any *reason* for one, I rejected it and tried to find a clear one. Some symbols were definitely satisfactory, for example, the torch for "education".'

(4) *Those choosing predominantly non-object figures*

(i) 8: 'I think I chose mainly for the *form* of the symbol.'

(ii) 11: 'At first glance, I almost rejected immediately the recognizable objects, which were usually clichés, and looked for another that better expressed my feelings.'

(iii) 12: 'I found that I tended to avoid the hackneyed symbol in every case.'

(iv) 12: 'I tended to avoid the most conventional one, and preferred the abstract ones. But where no abstract one seemed suitable, I didn't think the card as a whole was any good. I didn't consciously try to find a reason for my choice, and didn't try to associate the abstract ones with any particular object.'

(v) 12: 'I had an absolute prejudice against anything representing an idea by something associated with it. Occasionally some private association crept in, but I tried to avoid this in making my choice. If none of the symbols seemed suitable, I always took the most abstract.'

We can now summarize the main points that seem to be brought out by the subjects' reports.

It seems that the subject may base his choices consistently upon an attitude that may be not so much specific to the particular task in hand but general to his normal reactions and way of organizing his experience. This attitude may be concrete and conventional, so that easily communicable, clear and familiar objects will be chosen whenever possible as symbols, however abstract the word. Alternatively, the attitude may be one of rejecting the common and banal association, and preferring an abstract design or form, as expressing rather a subjective 'feeling' aroused by the word, not necessarily verbally communicable in any way. This 'feeling' may be the criterion by which a symbol is judged as 'good'. On the other hand, a symbol may be judged 'good' purely on the grounds of its familiarity.

Subjects who chose either a great majority of object-symbols or of feeling symbols were usually aware of their consistency of attitude, while other subjects were much less consistent, and varied from card to card. Nevertheless, in almost every case, the subject reported a definite bias towards either object-symbols or the more abstract symbols.

Finally, many of the subjects reported on the 'goodness' and 'badness' of certain symbols or sets of symbols, but their grounds for such verdicts vary considerably, so that what is 'good' for one will be 'bad' for another, and therefore the verdict appears to be made in relation to some personal or conventional frame of reference which itself may derive from a more fundamental subjective or objective attitude.

There is evidence therefore to show that certain of the signs used tended to stand out as particularly appropriate, but the basis for their fittingness as symbols for the words appears to vary considerably. The popular sign for 'visionary' is more suggestive and

evocative of its verbal setting than in any direct way representational. Other popular signs are purely objective, clearly and conventionally associative rather in the way that a pipe became symbolic for peace amongst the North-American Indians. Such are the tin-hat for 'war', and the key for 'freedom'.

On the other hand, some of the signs, such as the spiral for 'evolution', the two straight and parallel lines for 'law and order', and several others, were intended to be more schematic and expressive of a general and relational theme. While certain of these signs also were quite frequently chosen, there were not enough of these to make their selection a basis for inference as to perceptual attitude.

3. *The time taken in choosing*

Twenty-five of the thirty-four subjects were timed for the choice they made to each of the fifty cards—the time being taken from the moment the card was turned up until the subject had given out the letter of the sign he preferred. There was a considerable variation in the subjects' total time for the whole experiment, and a wide intra-individual variation, in the time taken for different cards. We shall examine first the differences between individual subjects, in order to find out whether there is any relation between such differences and the type of choice made. Secondly, we shall examine the variation within the cards themselves, in order to find out why the choices for one card take longer, and whether there is any relation between the time taken to choose and the consensus of agreement of choice.

(1) *Times taken by individual subjects*

In Table 3, the range of difference is shown together with the Average Response times (Av. R.T.) and standard deviations (S.D.), in seconds, for the fifty choices made by each of the twenty-five subjects.

Table 3

Av. R.T.	31·26	28·78	20·34	18·72	18·58
Range	15–48	10–64	6–54	7–46	5–50
S.D.	8·26	11·23	10·84	8·18	9·95
Av. R.T.	17·36	16·86	16·58	15·00	13·46
Range	5–50	6–49	5–45	8–55	6–30
S.D.	9·22	8·96	9·34	7·50	5·04
Av. R.T.	12·94	12·84	12·84	12·54	12·54
Range	7–27	6–33	5–32	5–31	4–36
S.D.	4·36	4·98	5·48	5·27	7·55
Av. R.T.	12·24	11·92	11·76	11·34	10·82
Range	3–25	4–26	4–43	3–26	3–24
S.D.	5·36	5·12	6·92	5·74	4·86
Av. R.T.	9·98	9·08	8·42	7·82	6·96
Range	5–25	3–18	3–24	3–61	4–13
S.D.	3·94	3·39	4·08	5·5	3·90

Thus the individual variation in Av. R.T. ranges from a minimum of 6·96 sec. up t maximum 31·26 sec.—approximately 24 sec. difference. The distribution of the means i shown in Fig. 2, the means being grouped in 2-sec. units. It will be seen that 92% of th subjects (twenty-three out of twenty-five) come within the range 6–22 sec., the remainin two being extreme cases.

While, on the whole, the standard deviations decrease with the decline in Av. R.T., thei are also certain differences in the individual's consistency of response-time. In som

nstances where the S.D. does not follow the general trend of the Av. R.T. decline, this is due to a subject's taking a particularly long time in choosing for one particular card, for example, 60 sec. where his average for the remainder would be about 10–12 sec. Nevertheless, there is some individual variability in this respect, but there appears to be no relation between the *type* of sign chosen and the time taken in choosing.

It seems, therefore, that the differences in the times taken by individuals to choose from the sets of signs indicate a difference of general attitude on the part of the subject in dealing with the material.

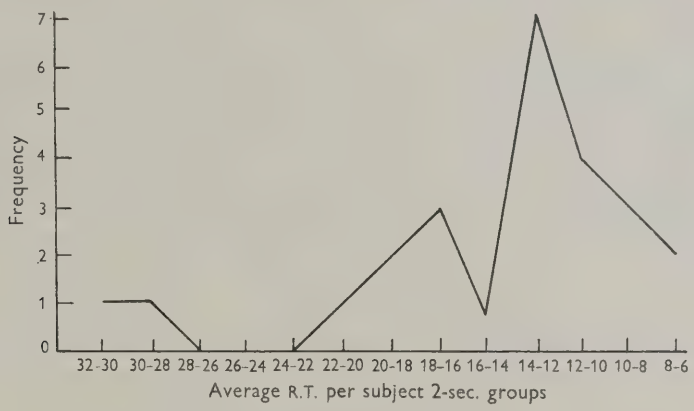

Fig. 2.

2) *Times taken in choosing for each card*

The average times of the twenty-five subjects in choosing for each of the fifty cards range from 9·76 to 23·00 sec., and the S.D. from 4·766 to 16·020 sec.

In Table 4, the cards for which the response times were extreme are shown, with first the five cards with the quickest R.T., and then those with the longest R.T. The distribution of choices made for the signs on these cards is also shown.

Table 4

Word	Av. R.T. (sec.)	S.D. (sec.)	Distribution of choices				
Energy	9·76	4·766	17	4	3	1	0
Law	10·68	4·604	9	7	4	3	2
Luck	11·00	4·600	15	6	3	1	0
Ambiguity	11·32	5·273	10	8	3	3	1
Education	11·52	7·348	8	8	7	2	0
Fear	23·00	16·020	18	4	2	1	0
Wisdom	20·17	13·540	12	6	4	2	1
Atheism	19·12	10·160	7	6	5	4	3
Unconscious	18·24	15·490	13	6	4	2	0
Thought	17·80	9·945	8	7	6	2	2

Perhaps the feature in common for those cards for which the longest R.T.'s were recorded is that no purely conventional connexion is clearly illustrated by any of the signs. For example, for fear, while the sign suggesting a dark cloud obscuring the sun is definitely the most popular choice (eighteen out of twenty-five), the average R.T. for these eighteen choices is 19·12 sec., with a S.D. of 12·86, and a range from 5–50 sec. It seems likely, therefore, that in this case, while the agreement in choice is high, it is the lack of clear and familiar relevance of the signs which causes the wide variation and high average R.T.

With regard to the other five cards, having the shortest average R.T.S, the comparative familiarity of some of the signs is clear. For example, for 'energy', the sign representing the sun is chosen seventeen times out of twenty-five, with an average R.T. of 10·40 sec., and a S.D. of 4·593, range from 5–25 sec., for card 37, 'law and order', the agreement of choice is comparatively small, but the policeman's helmet sign and the parallel lines sign account for sixteen of the choices, with an average R.T. of 10 sec., and a very small variation. Again, for 'luck', the simple horseshoe sign is chosen fifteen out of twenty-five times, with an average R.T. of 9·3 sec., and the clover leaf sign six times, with an average R.T. of 9·7 sec.

The response times seem therefore to show clearly that the quickest choices are made for those signs which stand out either for their meaningful simplicity of structure—such as the popular sign for 'law and order'—or for their clear and conventional familiarity, such as the sun for 'energy', the horseshoe for 'luck'. While the evidence is insufficient for a positive conclusion, it seems likely that the type of sign which would be most immediately selected as appropriate would combine some simplicity and regularity of form with a clear fittingness to the meaning of the verbal setting.

IV. Discussion

From the results, there seems no doubt that the preference for clear and unequivocal signs rather than for signs which attempt to reach the less conventional, personal structure of experience, reflects a general attitude in dealing with perceptual material in relation to abstract words. This attitude implies a preference for signs which are verbally communicable and describable as opposed to those which emerge from the feeling-stage of apprehension.

Such general attitudes in perception appear to have been first understood by Wulf(6) who described in his subjects two main 'modes of apprehension' when dealing with simple designs. In the one, the comprehensive, the subject tends to name the whole design from the general impression it gives him. In the other, the isolative, the subject tends to analyse the design and is more concerned with the objective accuracy of his perception. These two attitudes suggest basic differences in viewing the environment and relating it to the personal, subjective background.

It is possible that the differences observed in the present experiment are due to attitudes whose nature is similar to those that Wulf described. It is possible also that they may relate to temperamental differences such as Sheldon(5) describes. According to him, the extreme cerebrotonic is distinguished by his 'vertical mental cleavage', his avoidance of the obvious in his verbalization, his acute awareness of his own mental life coupled with an isolation from the popular or conventional environment outside him. The extreme somatotonic is the opposite of this, his mental cleavage being 'horizontal'. That is, he is cut off from subjective awareness and directs his energies outwards. As Sheldon points out, Jung's introversive and extraversive attitudes have much in common with these two components.

Whether or not the differences we have found can be explained in terms of such general attitudes, there is little doubt that the type of material has attained to modes of response below the perceptual level. Piaget(4) observes how the child's *understanding* of words is egocentric. 'Egocentrism', he says, 'is the denial of the objective attitude, and consequently of logical analysis' (p. 140). It therefore gives rise in the child to what he calls

subjective synthesis' or 'syncretism' which is a primitive mode of thinking. The impression from our present results, particularly when considered with reference to the subjects' justifications for their way of choosing a sign, is that many subjects choose the more objective, public or conventional sign whenever feasible, but that others choose *because of the way a sign affects them personally* rather than considering whether or not such a sign has any meaning for other people. It seems that these two attitudes may well be interpreted on the basis of Piaget's principles, and that they may explain to some extent Bartlett's observation on the feeling of fittingness that a few of his subjects experienced.

Probably, as was suggested by the previous experiment on this subject(2), another factor influencing the choice of a sign is its simplicity and economy of structure. Mental organization at the adult level requires some simple aesthetic, although to speak in this connexion of the 'goodness' of the Gestalt is scarcely adequate as an explanation.

Little experimental work has been done to investigate the many underlying factors in thinking and the use of symbols in mental organization. The implications of Piaget's studies on children's language and thought have not been developed in relation to the thinking of adults. The present study indicates some of the factors involved, and the method may be of use in further exploring this field of affective-cognitive relationships. Jung(3) thought it possible that 'in the unconscious, feeling and concept are not clearly separated, perhaps even are one' (p. 93). The nature of this unity he does not attempt to describe, but further investigation of the pre-logical thinking of adults is clearly of importance.

V. Summary and conclusions

1. An experiment is described in which the nature of the fittingness of symbols to words is investigated. Fifty words, each with five possible symbols varying from representational to vague and almost meaningless, are given to the subject with the task of choosing the symbol he considers most appropriate to the word. The experimental situation allows for spontaneity of choice and requires no justification for a choice, except at the end when the subject is questioned regarding his attitude and method of approach. Thirty-four subjects, all of university education, of both sexes, and varying widely in academic background, took part in the experiment.

2. For several words, the agreement in choice of a sign as the most appropriate is high, but the type of fittingness varies. While some signs of obvious conventional significance are chosen, it seems probable that those signs which combine the formal qualities of simplicity and regularity of design with a familiar structural appropriateness to the verbal setting are both the quickest choices and the 'best symbols'.

3. With this type of material, there is definite evidence to show that individuals vary considerably in their mode of relating the signs to their verbal settings. On the one hand, there is a tendency always to choose, wherever possible, a sign which is clearly recognizable in its conventional significance; on the other, there is a tendency to avoid the conventional association and to look for a more personal and impressionistic, formal quality in the sign, which would suggest the verbal setting.

4. The fittingness of a sign to a word is found to be a complex process, as Bartlett observed, depending upon a variety of factors both inherent in the material used and arising from individual differences in what appear to be fairly general modes of apprehension.

5. The differences in mode of apprehension, therefore, may be general to the way in which an individual reacts to such perceptual material, and to the way in which he relates it to his experiential background The pronounced individual variations in the type of symbol preferred may perhaps be interpreted as due to differences in temperament of a fundamental kind. These are discussed with reference to the importance of affective factors in thinking.

I wish to thank Mr R. C. Oldfield of the Institute of Experimental Psychology, Oxford, for his help and advice in carrying out this experiment.

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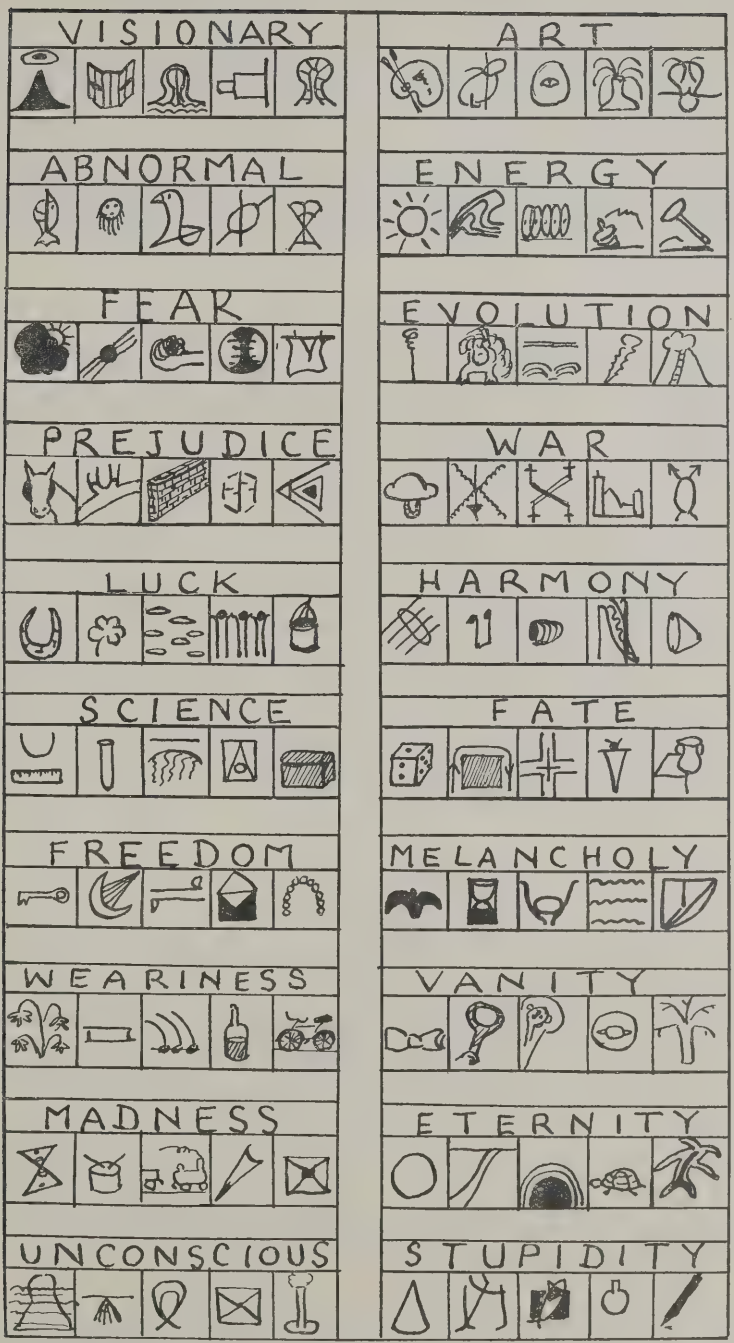
APPENDIX


VISIONARY
ART
ABNORMAL
ENERGY
FEAR
EVOLUTION
PREJUDICE
WAR
LUCK
HARMONY
SCIENCE
FATE
FREEDOM
MELANCHOLY
WEARINESS
VANITY
MADNESS
ETERNITY
UNCONSCIOUS
STUPIDITY

ANTICIPATION IN MEMORIZING

By H. KAY and E. C. POULTON, *The Psychological Laboratory, University of Cambridge*

I. *Introduction* (p. 34). II. *Experimental arrangement* (pp. 34–35). III. *Results* (pp. 35–36). IV. *Discussion* (pp. 36–40): (*a*) *Effects of anticipation upon memorizing* (pp. 36–38); (*b*) *Immediate retention as an active process* (pp. 38–39); (*c*) *Factors underlying the laws of primacy and finality in learning* (pp. 39–40). V. *Summary* (pp. 40–41). *References* (p. 41).

I. Introduction

The temporal antithesis of the title is verbal, not psychological. In the study of memory, time concepts have been put forward both in Freud's theory that a present repression may be controlling the recall of a past memory, and in Bartlett's experimental findings that a past experience may be controlling present memorization. The hypothesis of this experiment is a logical development from Bartlett: that a further factor affecting present memorization is the anticipation of future requirements. It would seem that the organism struggling to find 'release from the narrowness of presented time and place' so memorizes the temporally experienced event that it is orientated and organized in relation to the temporally anticipated event. Time, and not only the experience of time past, but the anticipation of what time will bring, acts as one of the variables influencing the 'isolated' present stimulus and ensuring that it shall be neither isolated nor unmodified. As an active process, often endeavouring to record the actively changing forces of a present receding into a past, memorization operates in part by anticipating the conditions under which the learned material will be recalled.

II. Experimental arrangement

The thirty-two subjects used in this experiment were naval ratings, aged between 18 and 26. Each subject performed the experiment separately. Immediately in front of him on the edge of a table were two four-way joystick keys, one for each hand. Beyond these, at a comfortable distance, was a semi-transparent screen, on which were projected from behind, two circles side by side. In each circle was an arrow, which pointed North, South, East or West. The subject was told that the two circles corresponded to his two keys, and the arrows to the directions in which he had to move the left and right keys respectively. The sixteen different combinations of the four left- and four right-hand display directions were randomly arranged on a film strip. The display was changed by an automatic projector. The subject's responses were electrically recorded, and the circuit was so arranged that an auditory stimulus ensured that the subject would maintain the requisite speed of responses.

Each subject received a standard practice period of about 45 min. on a day preceding the experiment, during which he learnt the experimental procedures, and a further short practice period immediately before the experiment started. The experiment itself consisted of twenty episodes, during each of which the subject had to memorize eight display

ems, at a speed of 2 sec. per display, and subsequently to make the appropriate responses t a speed of 2 sec. per response.

There were four different procedures, their order being randomized in Latin-square orm. In A the subject had to recall the first series of four items immediately after learning , and then learn and recall a second series of four items similarly. In B_1 the subject had o learn the second series of four items immediately after learning the first, and then recall hem in the same order, the second immediately after the first. In B_2 the subject had again o learn the second series of four items immediately after the first, but to recall the second eries before the first series. Procedure C was identical with B_1 except in name. The order ithin each procedure is shown diagrammatically in Table 1.

Table 1. *The four experimental procedures*

Procedure	Order within procedure	Whether order of recall known during learning	Abbreviation used in text
A	Learn 1–4, recall 1–4, learn 5–8, recall 5–8	Known	$L_1R_1L_5R_5$ known
B_1	Learn 1–4, learn 5–8, recall 1–4, recall 5–8	Ambiguous	$L_1L_5R_1R_5$ ambiguous
B_2	Learn 1–4, learn 5–8, recall 5–8, recall 1–4	Ambiguous	$L_1L_5R_5R_1$ ambiguous
C	Learn 1–4, learn 5–8, recall 1–4, recall 5–8	Known	$L_1L_5R_1R_5$ known

Each time he changed the display, the experimenter called out the corresponding display osition, so that the subject was presented with a frame of reference into which to fit the ems he was learning, e.g. 'B one... two ... three ... four ... five ... six ... seven ... eight'. efore each episode the subject was told which procedure A, B, or C was to be used. But ith the two B procedures he was not told whether to expect B_1 or B_2. Thus in these two rocedures the subject did not know which of the two series of four items he would be ked to recall first, until after he had learnt all eight items, when the experimenter would y 'now record B one to four' or 'now record B five to eight'. Although procedures B_1 nd C were objectively identical, except in name, subjectively they were different. For hereas in procedure C the subject knew the order in which he would be expected to recall ne items before he started to learn them, in procedure B_1 he did not know the order of ecall until he had finished learning them. This is shown diagrammatically in Table 1.

The starting-points on the film were so arranged for the different subjects that each splay item came an equal number of times in each position for the group of subjects as whole. There was a $\frac{1}{2}$ min. interval after each episode, during which the subject was ven encouragement but no knowledge of results; and a 3 min. interval at half-time after ne first ten episodes. The whole experiment took about half an hour. Each subject per-rmed it once only.

III. Results

(1) With procedures B_1 ($L_1L_5R_1R_5$ ambiguous) and C ($L_1L_5R_1R_5$ known) the items in ne series learned first were recalled significantly more correctly than those in the series arned second.

(2) With procedure B_2 ($L_1L_5R_5R_1$ ambiguous) the items in both series were recalled ually correctly.

(3) In none of these procedures were the items as well recalled as with procedure A $_1R_1L_5R_5$ known). This is shown in Table 2.

Table 2. *The mean percentage of items recalled correctly in each series for the different procedures*

Procedure	A ($L_1R_1L_5R_5$ known)	B_1 ($L_1L_5R_1R_5$ ambiguous)	B_2 ($L_1L_5R_5R_1$ ambiguous)	C ($L_1L_5R_1R_5$ known)	5% point for differences
Mean percentage of items recalled correctly in series learned first	46	36	30	39	5
Mean percentage of items recalled correctly in series learned second	46	31	30	32	

(4) With procedure C ($L_1L_5R_1R_5$ known) the number of items recalled correctly in each serial position gave the typical U-shaped curve found in experiments on the rote learning of nonsense material. But with procedure B_1 ($L_1L_5R_1R_5$ ambiguous) the series learned second was recalled with decreasing correctness from item number five to item number eight, the last item being recalled significantly less correctly than with procedure C. Thus the typical U-shaped curve became humped in the middle. This is shown in Fig. 1. An identical trend was found in two previous pilot experiments.

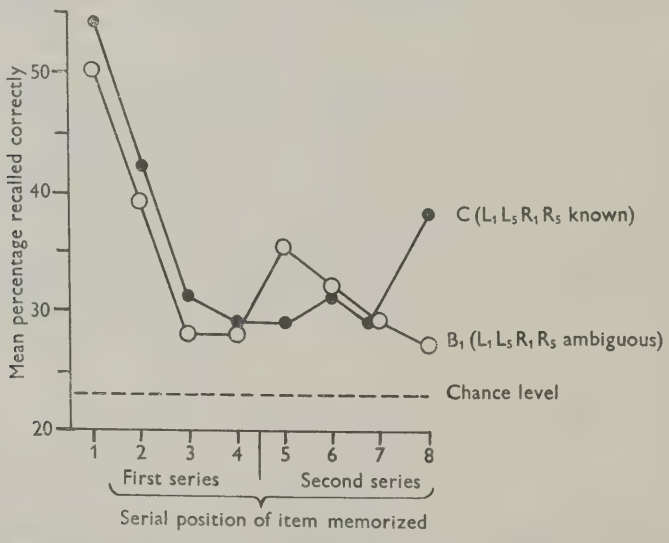


Fig. 1. The mean percentage of items recalled correctly in each serial position, for procedures B_1 ($L_1L_5R_1R$ ambiguous) and C ($L_1L_5R_1R_5$ known). ○, procedure B_1; ●, procedure C. To be significant differences mus be 10 or greater. The dotted line gives the level of chance guessing.

IV. Discussion

(*a*) *Effects of anticipation upon memorizing*

It will be seen from Fig. 1 that procedure B_1 ($L_1L_5R_1R_5$ ambiguous), in which eight item were learnt by a subject who did not know at the time he was learning them whether h would be expected to recall them in the order in which he had learnt them, or whether h would have to recall the second four before the first four, resulted in a curve with a hum in the middle when the mean percentage of correct items was plotted for each seria position. But procedure C ($L_1L_5R_1R_5$ known), in which the eight items were learnt wit the knowledge that they had to be recalled in the order in which they had been learn

resulted in the typical U-shaped curve of the conventional experiment on the rote learning of nonsense material. Yet the actual order of memorization and the required order of recall were identical in both procedures. The difference between the two curves is therefore ascribed to differences in the method of memorization used by the subject with these two procedures, and the differences are determined by the order in which a subject anticipates that he will be expected to recall the items. It will be noticed that it is *not* that the subject has been instructed to memorize items in any one manner; but it is the knowledge or lack of knowledge of what will be the method of recall which is sufficient to bring about this different result.

The theoretical explanation of how this is achieved follows very closely Bartlett's(1) discussion of attitude and its particular development in Zangwill's(7) article on 'Attitude in recognition'. In such discussions both sensory patterns and psychological attitudes are seen as 'co-determinants of the perceptual response'. The differences in the methods of memorization in the present experiment are ascribed to differences in the attitude or 'preparatory set' of the subject. The patterns of stimulation remain the same, but different 'preparatory sets' towards that material have been established by the subject's anticipation of how he would have to recall the items. The experiment brings out how ready the subject is to form a set (whilst acknowledging the results of latent learning experiments, it does not seem an exaggeration to say how basic is the establishment of some set to normal learning) and the possible diversity of such sets as may be formed. As a corollary to this, the results emphasize how often phenomenal dominance is of a subjective nature. In procedure B_1 ($L_1L_5R_1R_5$ ambiguous) it is the first item of the second series no. 5 which is dominant, and which has been memorized better than the last item no. 8; whereas with the conventional preparatory set in procedure C ($L_1L_5R_1R_5$ known) it is the last item which becomes dominant and is the better learned. It is of note that in this experiment some subjects were aware that they were trying to retain the dominant items. It should be possible to achieve the same results where the anticipation causes an 'unwitting revaluation of dominance'.

This viewpoint stresses the limitation of mechanistic theories on the serial learning of nonsense syllables. Such theories have concentrated upon the interaction between different items in the learned series, and tend to account for the serial position effects purely in terms of inhibitory potential, said to be mechanically determined by serial position. More recent work is attempting to broaden this outlook (e.g. Postman's(3,5) articles on the analysis of set in rote learning). The present view suggests that in learning, subjects give individual priorities to different items, the order of priorities being that which they, more or less deliberately, consider to be the most suited to their attempts to recall the maximum number of items. Serial position effects are at least partly the result of such priority decisions. In serial rote learning, key items act as reference points, and it is from such points that memorization of the whole is achieved. In the early stages of memorization the learner is constantly having to return mentally to his reference points; the newly established learning is hinged upon them. The first item in particular and the last to a lesser extent, with their relatively figural positions, are especially suited to act as salient references. The subject's success in recalling these items will be particularly noticeable if lack of practice, the massing of trials, or the high-speed presentation of items, means that learning as a whole tends to be relatively unsuccessful. This applies equally to the single heterogeneous item which also stands out figurally.

These features of learning are so commonplace that they can be misleading. A method of learning which is a convenience, is not a necessity; it is liable to modification for an extension of the same reasons which have brought it into being, namely that the reference points must accord with the method of recall. As in perceiving, so in memorizing the subject structures the learning field according to his own particular set, so that certain items assume dominance within that field. Without being unduly influenced by current motivational theories, we can take it that, in a human experimental learning situation, and also in everyday life, particularly under present educational methods, the process of memorization is directed. Material tends to be memorized with some idea, however vague, of the conditions under which the material is to be used, and consequently how it can best be learned. Anticipation of how the learned material will be utilized is one of the variables affecting the mental set of the subject. Thus anticipation of recall, generally neglected or treated as a subjective factor somewhere on the periphery of the learning process, becomes one of the central determinants in learning. There is no wish to identify this view with any particular school of learning, but it is obvious that it tends to support theories which propose that expectancies are established, and that habits are dependent upon such expectancies, rather than the opposite viewpoint that the habits themselves are strengthened by reinforcement.

(*b*) *Immediate retention as an active process*

It will be seen from Table 2 that when the second series of four items was recalled immediately after memorization, it was recalled far less accurately with procedure B_2 ($L_1L_5R_5R_1$ ambiguous) when the subject had not yet recalled the first series of four items, than with procedure A ($L_1R_1L_5R_5$ known) when the subject had already recalled the first series. Yet the amount of simple pro-active inhibition on the second series with these two procedures was presumably about the same. In the B_2 procedure, the first series of four items was learned immediately before the memorization and the recall of the second series; the interference here upon the second series could not be expected to be greater than that in procedure A, where the first series was both memorized and recalled before the second series. The essential difference between the two procedures was that with B_2 the subject, whilst memorizing the second series, had still to recall the already learned first series. The difference arose from the active efforts which the subject made to retain the already learned material. This seemed to affect his attempts to memorize the subsequent material in the second series. Some subjects were certainly aware that this effort to maintain one series and to memorize another, using the same type of material with the same sensory appeal, was a severe curtailment upon the learning of the second series. They reported that they were unable to 'concentrate' sufficiently upon all the items in the second series whilst maintaining the first. For they knew from past experience that if they did so, they might be able to recall few if any items in either series. Such a mental set in the field of learning shows similarities to Bills' 'Amount Set'(2) in the field of human performance.

This finding stresses that the retention of recently memorized material is an active process having significant consequences upon the memorization and recall of subsequent material. It suggests that theories of retro-active and pro-active inhibition need to be broadened. A hypothesis such as Melton's two-factor theory of retro-active inhibition, useful as it is in illustrating the different types of reaction which may be contributing to

the retro-active process, is limited mainly because of the limitations of the experiment from which it is derived. Melton attributes retro-active inhibition to 'two factors: namely, the "unlearning" of the original responses at the time the interpolated responses are being learned, and the "competition" of the original and interpolated responses at the time of attempted recall of the former....The pro-active inhibition of the *learning* of the interpolated list, when present, is assumed to have no permanent effect on the strength of the associations involved in the interpolated list.' (4)

In situations where the retention is as active a process as in the present experiment, it seems unlikely that pro-active inhibition would have no permanent effect on the learning of the interpolated series. Nor does it seem logical to attribute the effects to two distinct time stages; retro-active and pro-active processes are essentially interactive processes, the one co-existing with the other, and certainly where retention is an active force, they are not confined to any particular temporal stage. The degree to which such interference may take place does seem to some extent to be within the subject's control, as the different results with procedures A ($L_1R_1L_5R_5$ known) and B_2 ($L_1L_5R_5R_1$ ambiguous) indicate.

This concept of active and continued competition between retention of original material and memorization of later matter has varied implications for learning theory. Such a competitive process presumably takes place whenever a subject attempts to learn a long task. It would seem as if the subject's available 'energies', a finite quantity, are divided between trying to retain the old and memorizing the new. Thus it provides part of the reason for the proportionally greater time required to learn a long task as compared with a short one. This is not to deny that there may be simple interaction between the different parts of the learned task.

Again, active competition between retention and memorization offers additional reason for the efficiency of learning by wholes, as compared with learning by parts. In the whole method of learning, whilst the subject is memorizing, his efforts at retention range over the whole task, not over a part of it, so that a certain amount of 'rehearsal' of the whole material may be taking place whilst the actual learning proceeds. The part method would preclude this; it would only allow rehearsal of those parts which had been learned, so that the method is more uneven. The early parts are overlearned at the expense of the later.

A number of experiments have been performed to ascertain the effect of failure to complete a task upon its recall, or resumption under suitable conditions after a short time interval (e.g. Prentice (6)). This experiment suggests that such an uncompleted task may also have a detrimental effect upon tasks performed immediately afterwards, particularly if completion is anticipated at some near time in the future. This is a possibility which does not yet appear to have been investigated; its practical application to present educational methods would seem to make it worthwhile.

(c) *Factors underlying the laws of primacy and finality in learning*

From a comparison of procedures B_1 and B_2 in Table 2, it will be seen that the series of four items which was both learned first and recalled first ($L_1L_5R_1R_5$ ambiguous) was recalled significantly more correctly than any of the other three series. When the series was either learned second ($L_1L_5R_5R_1$ ambiguous), or recalled second ($L_1L_5R_5R_1$ ambiguous), it was recalled significantly less correctly.

These findings, together with the results upon the expected order of recall, suggest that the so-called 'Laws of Primacy and Finality' are dependent upon at least three separate

factors, in addition to any interaction that there may be between different items in the series:

(i) *The order of learning.* As described in § IV(*b*) above, this partly determines the degree of learning of the individual items.

(ii) *The order of recall.* This would seem to influence the number of items which are recalled correctly for any degree of learning.

(iii) *The expected order of recall.* As described in § IV(*a*) above, this partly determines which items become subjectively dominant or key items, and are consequently better learned.

In conventional rote-learning experiments all these three factors favour the correct recall of the first items in a series. But only one of these factors favours the correct recall of the last items. This is the expected order of recall, which determines that the last items shall become subjectively dominant, and consequently better learned. For such dominance to occur, the subject must presumably know the length of the series in advance, i.e. know that the last items are the last items, while he is actually learning them.

It could be said that the Laws of Primacy and Finality are the results of rote-learning experimental artefacts. The laws are obeyed because each situation follows the same rigid order of learning and recall. When this order is varied, as in the present experiment, it is seen that these two laws simply illustrate the action of certain more basic determinants in the learning process. In so far as conventional rote-learning experiments reflect widespread methods of learning and recall, their results have general application. The danger lies in thinking that the tendencies which they reflect are inexorable; custom only has made them so.

V. Summary

1. The effect of the subject's anticipation as to when and how he will have to recall material, is to establish a preparatory set. This set acting as one of the 'co-determinants in the perceptual response' restructures the presented material. A change in subjective dominance changes the normal priorities in the learning process.

2. Such anticipation is not restricted to the experimental situation. Memory is often directed; the end determines the manner of memorization.

3. Anticipation is thus a central determinant in learning; its relevance to serial learning theory is discussed.

4. Results stress that retention is an active process interfering with subsequent memorization and recall. Differences from the two-factor theory of retro-active inhibition are noted.

5. Active retention offers additional reasons for the efficiency of certain methods of learning.

6. In immediate memory the order of recall affects the correctness of the recall of items

7. The so-called 'Laws of Primacy and Finality' in learning can in part be looked upon as the results of stereotyped procedures in the conventional rote-learning experiment They simply illustrate the action of certain more basic determinants in the learning process

We are greatly indebted to Prof. Sir Frederic Bartlett, F.R.S., for the theoretical background out of which this experiment has developed; also to Dr N. H. Mackworth who designed the experimental apparatus, and to Mr A. T. Welford who advised us in the design

of the experiment. Miss V. Cane very kindly suggested the method of calculating the level of chance guessing in Fig. 1. The experimental subjects were supplied by the Royal Navy. The experiment was carried out while we were in receipt of grants from the Nuffield Foundation and the Medical Research Council respectively.

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THE EXPERIMENTAL STUDY OF THE TRANSMISSION OF RUMOUR[1]

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I. Introduction

Perhaps the first person to attempt an experimental study of rumour was the seventeenth-century M.P., Thomas Chaloner, of whom Aubrey wrote:

> He had a trick sometimes to goe into Westminister hall in a morning in Terme time, and tell some strange story (sham), and would come thither again about 11 or 12 to have the pleasure to heare how it spred; and sometimes it would be altered, with additions, he could scarce knowe it to be his owne (3).

And many before now have used this or similar methods to show the fallibility of human reporting.

But of the more strictly experimental studies of rumour and rumour transmission, the origins lie in the work of William Stern on testimony (7) and of Sir Frederic Bartlett on remembering (4). Although neither of these actually carried out experiments on rumour their findings of the ways in which individuals perceive, recall and report on what they have heard and seen, have a very great bearing on this topic. This is apparent from the work of Gordon Allport and Leo Postman, who in 1945 published an article entitled 'The basic psychology of rumour', following this up, two years later, with a book on the same subject which reported an extensive series of experimental approaches to the subject from which the following studies derive (1, 2).

II. Method of investigation

The method used by Allport & Postman was very simple; a slide depicting some fairly detailed situation was thrown on a screen. Six or seven subjects, who had not seen the picture, waited in an adjoining room. The first subject came in, and was so placed that he could not see the picture, while the experimenter, or someone from the audience, describe the picture to him. This done, the subject then repeated his version of the original description to the second subject, and so on until all the subjects had heard the story and repeated it. Each subject, having given his or her version of the story, then joined the rest of the audience, and was able to see the picture and listen to the gradual transformation of the story as it was passed on from one subject to the next.

In our own experiments, this method was very easy to use, though with the small groups of from five to twenty subjects, on whom these experiments were carried out, it was not always possible to have an 'audience' as Allport & Postman did, although the subjects as remained in the experimental room to listen to the conclusion of the experiment. This point is possibly important, as some experiments of Allport & Postman's show that the effect of an audience is to make the subjects more cautious and to shorten their reports.

[1] A paper read to the Experimental Psychology Group, in May 1950.

In order to make analysis of the successive versions of the stories used both easier and more accurate, each subject's reproduction of the story was recorded on a Wirek recorder, and subsequently transcribed. This made it possible to get a far better idea of the whole course of the rumour from replaying it over the Wirek, and also helped to show where changes in the narrative took place owing to mishearing of the reporter's words.

III. The subjects

Six groups of subjects were used; the first group was a W.E.A. class, of four men and one woman, between the ages of 30 and 40; the second group was an Evening Class of students studying for an external degree in psychology, most of whom were teachers, again aged between 30 and 40. The next two groups were both of Social Science students of Liverpool University, aged between 20 and 30, containing both men and women. The fifth group consisted of six volunteers from the English Speaking Union, a mixed group all under 30; and the last group were seven first-year students taking psychology as one subject among many. These were of much the same age as the other student groups.

All the experiments, except one, were carried out in the Department of Psychology of Liverpool University; the one exception being that with the volunteers from the English Speaking Union, which was carried out in the British Council at Liverpool.

IV. The stories used

Each group of subjects did three different rumour experiments, while the Social Science students did one extra one, making some twenty experiments in all. Three small supplementary experiments were used to test various hypotheses arising from the ones previously used.

One slight variation of Allport & Postman's method was used: for two out of the three main experiments for each group, the experimenter read the original story to the first subject; in the third, the first subject was shown a picture and was asked to describe it to the second subject, who was not, of course, allowed to see it. In the extra story, used for the Social Science students, and in the supplementary experiments, the experimenter again read the story to the first subject.

Whereas Allport & Postman had used semi-dramatic pictures—an argument in a subway train, a battle scene, a riot, and a street scene, the materials used in these experiments were somewhat simpler. The first story was a description of a street scene in Soho, the second was a report of an argument in an hotel lounge; while the third experiment showed a picture of a group of youngish people at a meeting, some of whom were throwing eggs at the speaker. It was this picture that was used for the experiment in which the first subject described the scene to the second and so on.

As, however, it was felt that the various stories used bore little resemblance to rumours of the kind that the subjects were likely to hear, the extra story was given to the two groups of Social Science students. This purported to be a conversation between the Professor of Psychology and his Senior Lecturer, about the forthcoming sessional examinations. It was hoped, that this would provide an 'ego-involving' situation, and might lead to some changes in the amount of the original recalled, as well as in the nature of what was recalled. The three supplementary experiments were designed to test the predictability of certain changes in the story, and consisted of a description of a fight in a railway siding, and two versions of a car and tram crash.

One further point concerns the number of details in the original story. Allport & Postman asked their subjects to give about 20 details, though exactly what constituted a 'detail' is difficult to say, for they give no criteria for this. In these experiments, when the experimenter has read the story, the number of details has been about twice as many as Allport & Postman used—the ego-involved story using 30, the others from 45 to 50. The criterion used for saying what was a detail and what was not, was the importance of an item or remark for the meaning of the whole story. For example. 'Six men were waiting' contains 3 details, the number of people, the sort of people, and what they were doing. While 'I am not sure what the fight was about' contains 2 details, an expression of doubt and the object of doubt. A phrase like '. . .for a few minutes later Eva came in' contains 2 details and not 3 because in that particular situation Eva could do nothing but come in. Had she swum in or ridden in, it would have been a different matter.

The instructions given to each subject were as follows: when they were to listen to the story they were told 'Listen attentively to what you are told', and before they repeated the story they were instructed to 'Repeat what you have heard as accurately as you can'. In the group of experiments in which the first subject had to make up a story from the picture he was shown, he was told 'Here is a picture, I want you to study it carefully and then describe what is happening in it to the subject here'.

Here are the scripts of the original stories:

(1) *The 'Fitzroy' story (all subjects)*

Six men were waiting for the Fitzroy Café to open at 45 Fitzroy Street at the junction of Warren Street in the West End of London, on a warm winter morning. None of them were smoking and as there were numerous indications that the café sold cigarettes, they were probably waiting to buy some. A group of three men was talking by a lamp-post, and a negro stood by the door under the telephone sign with his left foot raised. Two well-dressed men were standing with their hands in their pockets looking at me across the road. (46 details.)

(2) *The 'George and Eva' story (all subjects)*

I looked in at the Astoria on my way home—and who should I see sitting in a chair in the lounge but George; however he did not see me, which was perhaps just as well, for a few minutes later Eva came in. She was furious, but then George was not in a good temper either. He put down his glass and said 'Where the devil have you been?' 'Where d'you think?' she answered, 'Why were you such a blithering idiot as to rush off in the middle of the meal like that?' She stubbed a cigarette out angrily. 'Good heavens,' said George, 'surely I don't have to ask your permission every time I want to leave the room do I?' 'Don't be a vulgar ass,' Eva replied. 'But you knew quite well we had agreed to try and do the decent thing by Charles—and then you go and behave like that.' George looked down at his brown suede shoes and murmered something I could not catch; Eva looked so angry I thought she was going to hit him with one of those glossy magazines that lie about on the tables there; George looked up and said 'Well, he's such a darn fool—and I won't have a little bounder like that talking all that political twaddle in front o me; what does he know anyway? Has he ever seen a business man or a trade unionist?' 'But really George, Eva chipped in, 'he is my brother.' 'Well, I can't help that can I? You should have smacked him more when young.' And George got up and went out. Eva flounced off in the other direction, with her head in the ai and the feather in her hat bobbing up and down. (50 details).

(3) *The 'ego-involved' story (Social Science groups only)*

I overheard Prof. Hearnshaw talking to Miss Crawford about the sessional examinations. He said tha he thought that probably the papers were a little harder than they were last year, but that most of th students ought to be able to get through. Miss Crawford said that her paper for Course H seemed a fairl stiff one, but that she expected that at least 75% of the students ought to get through, always of cours provided that they did sufficient work in the meantime. The Professor said that he thought we shoul have to tighten up the regulations allowing people to take psychology, if we didn't get better results i

the sessional examinations than we got last year. To this Miss Crawford assented, and said she thought it would be a very good plan; but that in the meantime she would see what she could do about getting the experimental notebooks and essays up to date and corrected. (30 details).

V. Treatment of results

The successive versions of the various stories were transcribed from the Wirek recorder, and analysed in order to see what changes had taken place, both in number of details recalled and in the matter of the story. Bartlett has suggested that there are three main types of transformation likely to occur when the 'Method of serial reproduction' is used. He says:

> (1) There will be much general simplification, due to the omission of material that appears irrelevant, to the construction gradually of a more coherent whole, and to the changing of the unfamiliar into some more familiar counterpart.
>
> (2) There will be a persistent rationalization, both of a whole story and of its details, until a form is reached which can be readily dealt with by all the subjects belonging to the special social group concerned. This may result in considerable elaboration.
>
> (3) There will be a tendency for certain incidents to become dominant so that all the others are grouped about them ((4), p. 138).

The process whereby the original story is simplified due to the gradual omission of material is described by Allport & Postman as 'levelling'; that of certain incidents becoming dominant, with the others grouped around them, as 'sharpening', while the rationalization and constructive aspect is referred to as 'assimilation' of various kinds.

It has been found easiest to analyse the various reproductions in terms of these three processes. An 'Index of levelling' can then be prepared for each story, and statistical treatment of the results makes it possible to see whether there is any significant difference between the amount of levelling in one story and the next.

All the reproductions give fairly good illustrations of sharpening and assimilation, but it is difficult to get any quantitative studies of these, although this is an objective of future experiments.

VI. The results of the experiments

Levelling

Allport & Postman have defined the process of levelling as follows:

> As rumour travels, it tends to grow shorter, more concise, more easily grasped and told. In successive versions, fewer words are used and fewer details are mentioned ((1), p. 551).

Levelling is most apparent at the start of a series of reproductions, for the numbers of details that are retained declines most sharply between the first and third versions.

Fig. 1 shows the mean 'Index of levelling' for each of the different stories used. Various conclusions emerge from a consideration of this:

(1) *The 'Fitzroy' story*

Only five of the groups used this particular story, it not being possible for the W.E.A. class to do it in the time available. The mean index of levelling, shows that by the third reproduction, 74·5% of the details have been levelled out. By the last reproduction, only 9·4% of the original details remain.

Here are the final versions of the various groups:

Group B (*evening students*). There were a group of people on the corner of Warren Street and another street—a group of about six, apparently undecided what to do. It turned out to be a cigarette queue. On the opposite side of the road was a group of negroes, one with his leg in the air.

Group C (*Social Science students*). There were six men standing outside a café in Fitzroy Square. Two of them were white men. There was a negro standing by a telephone booth.

Group D (*Social Science students*). The picture shows some people bathing outside Fitzroy Square; there are several people bathing. One of them is a well-dressed white man, and there are some negroes.

Group E (*English Speaking Union*). There were six men standing outside a café in Fitzroy Street in London, and outside in the street there was a negro, standing on one leg, with one leg in the air.

Group F (*first-year students*). Two men were standing on the corner of Fitzroy Street. They looked as if they were standing on one leg and swinging their others.

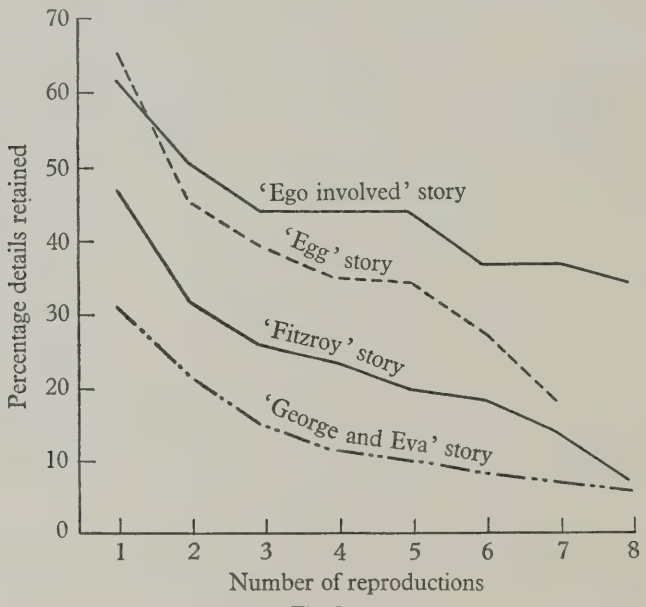

Fig. 1.

(2) *The 'George and Eva' story*

This proved to be the most difficult one of the lot, 85% of the details having been levelled out by the third reproduction. About 6% of the original details remained, on an average, by the last reproduction. With one exception, the first subject usually retained about 28% of the details in the version he told to the second subject; the one exception was a schoolmistress who recalled 46% of the original—in a manner not unlike the conversations to be overheard in buses and queues!

The final versions were as follows:

Group A. The other evening George was in the lobby of the Astoria, with his young lady. Her name was Eva. They both seemed to be in a bad temper, having quarrelled, probably about her brother-in-law called George.

Group B. I was sitting in the Astoria the other day when Eva came in. George said to Charles that he had been very rude to her the other day when he met him.

Group C. I was walking past the Adelphi the other day and I went in and saw George, and I sat in a corner opposite him. I also saw Eva. George was talking about politics, and after a while he flounced away for no apparent reason.

Group D. The other day I was walking down the street when I met my friend George. He was talking bout his brother and said he was talking a lot of claptrap.

Group E. I was sitting in the Astoria café the other day with Eva and Charles when George came in. seemed as if Eva wanted to hit George over the head with a glossy magazine.

Group F. On the way to work I met George in the Astoria, and his sister Eve came rushing in. The nversation took a political turn.

3) *The 'Egg' story*

Here, the first subject described the picture to the second, who repeated what he had eard to the third, and so on. Consequently, there were wide individual differences in the mount of details reported. One subject, in Group C, produced 32 details, another in roup B, 29, whereas for Groups D, E and F, 16 details (on the average) were given, and nly 7 by the first subject of Group A. Moreover, the manner differed enormously; the rst subject of group B gave a description not unlike that of a radio commentator:

There's what may be an Ensa performance here...there are separate chairs, you see, not like the plush ype of seats in a cinema; but the audience looks as if it had just been amused by somebody up in front of nem. There's one person sitting on his own up at the very front, leaning sideways in a very peculiar ttitude with his forearms crossed tightly across his body, although his arms are sticking out away from im, crossed and pointing forwards, in a sort of gesture of engrossed amusement, somehow...Everybody lse seems mainly amused, but I'm not too sure that what they can see themselves or are listening to is ctually a joke; I'm just not sure. They don't seem to be laughing at a joke; actually, you see they seem o be laughing at a visual effect, I don't know if you get what I'm after. No, they're not laughing uproar- ously. It looks as if one man is about to throw something—oh yes, an egg perhaps, that's right, the man ith crossed arms is just in a position of having just thrown something, you see, and the throwing arm just across his body in the final position of the movement, then there's another man who is about to row, he's got his arm raised up; there's something very much like an egg in it. The one who has thrown ie egg looks as if he has scored a bull's eye too, as a matter of fact. There are women there, not pparently throwing anything, amused though, yes, I think they are amused. There's one man looking the camera. I suppose they must be students. I don't know who they would be throwing at.

Contrast that with this more matter-of-fact description:

The scene consists of a student body sitting in a large hall on chairs; they are mainly males. There are ie or two females sprinkled among them. It is a purely informal gathering, some have their coats on, me haven't. They are smoking cigarettes and they are all rather delighted at what is going on in front them. It does seem as if they are watching some comedy act in a concert, and they are very pleased out the whole thing.[1]

enerally speaking, the various versions of the 'Egg' story were better retained, while the verage levelling was very much less than for the other stories, with the exception of the o-involved one. The final versions were as follows:

Group A. This is about a show and there appears to be some excitement about somebody on the stage, d someone is going to throw something.

Group B. This seems to be an old-fashioned story; three people sitting on a bench, one throws an egg the others and the others return the egg.

Group C. This is a picture of a group of men standing round in a semicircle. They are watching a picture ich can't be seen. There is a woman with a disdainful expression on her face; she is smoking a cigarette d she is talking to another man. There is a group of young people farther away, between the ages of and 28.

The great differences between individual interpretations of the same picture are clearly reminiscent of ilar findings using the Thematic apperception test pictures. One possible line of further research is to use the .T pictures for rumour experiments; one trial experiment along these lines has suggested that it would be uable to pursue it further.

Group D. This is a picture of a hall in which are some students, some with their coats off, some with their coats on. There seems to be a variety of them.

Group E. The picture is of a group of animated people, some sitting down, some standing up and all waving their hands about.

Group F. This is a picture of a holiday camp. You can't tell if it is winter or summer, because they've got fur coats on one arm and ice-creams on the other.

(4) *The 'ego-involved' story (Groups C and D only)*

This story was read to the two Social Science groups, whose sessional examinations were about three weeks ahead at the time. Far fewer details dropped out, and the main sense of the story was kept throughout. This is apparent from the final versions:

Group C. I overheard a conversation between Prof. Hearnshaw and Miss Crawford about the sessional examinations. Prof. Hearnshaw said that the sessional examination questions were rather stiff, but if the students worked well they should be all right. Miss Crawford said that she was quite pleased with the standard among her students.

Group D. Prof. Hearnshaw was talking to Miss Crawford about the results of the sessional examinations. He said he thought the paper was a hard one. Miss Crawford said that she thought that 75% would get through. He thought the standard should be raised.

To test the 'ego-involvement' hypothesis, the χ^2 test was applied to the indices o levelling, to see if there was any significant difference between the amount of levelling i the ego-involved story and that in the other stories. The results of this showed that th difference in levelling between the ego-involved story and the 'George and Eva' story the only other one in which conversation had to be recalled, was significant at more tha the 1% level of confidence. The difference between the ego-involved story and the 'Fitzroy story was significant at the 0·05 level, while there was no significant difference betwee the ego-involved story and the 'Egg' one. When χ^2 was applied to the 'Egg' story and th 'George and Eva' story, the difference in levelling was found to be significant at the 0·0 level.

It would thus appear that an ego-involved story stands a better chance of being mor completely recalled than a 'neutral' one. As to why there should be no significant diffe ence between the ego-involved story and the 'Egg' one, and a significant differenc between the 'Egg' story and the 'George and Eva' story, it is hard to say. Two possibl reasons suggest themselves:

(1) The subjects were ego-involved in the 'Egg' story—it was about people of roughl the same age as the majority of the subjects, who were doing things that they might we do themselves. Groups C and D both interpreted the picture as showing a group of your people, Group D making them students. χ^2 applied to the average levelling for the tw students groups and the ego-involved story showed no significant difference between th groups. Nor was there any significant difference between any of the individual groups c the 'Egg' story and the ego-involved one, except for Group B, where it was only ju significant.

(2) A more likely explanation is that the number of details in the original versions of th Egg story were far fewer than those in the ego-involved one, so the amount of levelling w less and the story was more easily remembered. The average number of details in t original version of the 'Egg' story was 18; the number in the ego-involved one, 30.

These two explanations can be tested by further experiments.

A further point is that the mean levelling index for the 'Egg' story approximates t more nearly to Allport & Postman's Index of levelling than do any of the other indic

obtained. Allport & Postman usually got the first subject to describe the picture to the second, as was done in this case, and also used about the same number of details.

What these results seem to indicate is that the amount of levelling depends very largely on the type of material used. A conversation, overheard in some place, and having no direct bearing on one's own personal life, will not be remembered as well as a scene that has been described, nor nearly as well as a conversation bearing on one's own future, present, or perhaps past. This latter point is perhaps obvious enough. The results confirm Allport & Postman's contention that levelling is greatest in the first three reproductions, and that the rumour story is never entirely obliterated, but assumes a form after about six or seven reproductions, which can easily be repeated by rote. As they point out, the levelling 'curve' is similar to the Ebbinghaus curve for decline in individual retention—in fact they suggest that 'Social memory accomplishes as much levelling within a few minutes as individual memory accomplishes in weeks of time' ([1], p. 551).

Sharpening

Sharpening is the reciprocal of levelling, for what remains of a rumour-story after most of the details have been dropped out is inevitably heightened by contrast. Following Allport & Postman, we may define this process as:

> The selective perception, retention and reporting of a limited number of details from a larger context.

Very often, there is little similarity between what is sharpened in one story and what is sharpened in the next—as the final versions of the various stories quoted above shows. Frequently, some trifling detail is seized on and the whole rumour becomes organized round it. Take, for example, the 'George and Eva' story as reported successively by Group E.

First Version. I was in the Astoria the other day and sitting down; and who should come in but old George. George was sitting down and then Eva came in, and she was in a frightful temper. She bounced up to George and George was not in too good a mood either; she said 'What do you mean by this, George. You know we agreed to do the right thing by Charles.' And George said 'Don't be such a frightful ass', and *I thought Eva was going to hit George with one of those glossy magazines that lie around the place*, and eventually Eva got up and flounced out.

Second version. I was sitting in the Astoria the other day and Charles walked in and he was in a bad temper; and just a little later, Eva walked in, and she was in a bad temper. She said to Charles 'What do you mean by it?' Charles said 'Well, we meant to do the right thing by George', and *I thought she was going to hit him over the head with a glossy magazine* but she stalked out instead.

Third version. I was sitting in the Astoria the other day when Charles walked in. He appeared to be in a bad temper. Then Eva came in and George said to Eva 'I'm sure we did right by George'. Eva *appeared to want to hit Charles over the head with a glossy magazine*, but Charles got up in a temper and stalked out.

Fourth version. I was sitting in the Astoria the other day talking to George and Charles came in. Then Eva came in and George started to talk to Eva and Eva looked as if *she wanted to hit Charles on the head with a glossy magazine.*

Fifth version. I was sitting in the Astoria café the other day when George and Charles came in. Then Eva came in and George began talking to her, and Eva looked as if *she wanted to hit George over the head with a glossy magazine.*

Sixth version. I was sitting in the Astoria café the other day with George and Charles when Eva came in. Eva looked as if *she wanted to hit George over the head with a glossy magazine.*

Seventh version. I was sitting in the Astoria café the other day with Eva and Charles when George came in. It seemed as if Eva *wanted to hit George over the head with a glossy magazine.*

For the same story, Group C sharpened the phrase 'political claptrap', which appeared in every version. In the 'Egg' story, Group C faithfully repeated the phrase 'a woman

with a disdainful expression on her face'; Group E sharpened 'an animated group of people'. 'A Negro with his leg raised' or 'with his leg in the air' appeared in Groups B, E and F, in almost every version of the 'Fitzroy' story. Group D sharpened 'a telephone booth'.

Among other forms of sharpening, Allport & Postman noted *numerical*, and *temporal* sharpening; 'large' men tend to become 'two men', and events tend to be described as happening in the immediate present. Any form of *movement*, such as men swinging their legs, throwing eggs, or even smoking, is also likely to be accentuated, while *relative size*, because it is apt to hold the attention, may also cause some item to be sharpened. Certain phrases, especially if they set the scene for the story may well be sharpened: 'I was sitting in the Astoria'; 'There were six men standing outside a cafe'; 'This is a picture of people at a holiday camp'. All of these seem to benefit from the '*primacy effect*'; they come at the start of the story, and are consequently better remembered. A final form of sharpening

Table 1

Group	Six Men	Fitzroy café	Fitzroy Street	Cigar-ettes	Lamp-post	Negro	Leg raised	Tele-phone	Well-dressed	No. of subjects
B	8	1	8	9	4	9	9	—	—	9
C	7	7	7	6	—	7	—	7	—	7
D	—	6	8	6	2	7	—	—	8	8
E	7	7	7	6	—	7	7	—	—	7
F	2	3	8	7	3	4	8	—	—	8
Totals	24	24	38	34	9	34	24	7	8	39
Mean	4·8	4·8	7·6	6·8	1·8	6·8	4·8	1·4	1·6	7·8

is seen in the way in which explanations are added to a story, in an effort to apply 'closure', and thus make the whole tale more complete. For example, the 'Fitzroy' story was purposely rather vague in its description of what the men were waiting for; Group B sharpens this into a cigarette queue.

It does not seem possible to predict what items are likely to be sharpened, so much depends on individual caprice as to what holds the attention in the story. But for the 'Fitzroy' story, it was possible to count the number of versions in each group which mentioned such items as 'Six men', 'Fitzroy cafe', 'Fitzroy Street', 'Cigarettes', 'Lamp-post', 'Negro', 'Well-dressed', and 'Telephone'. The results given in Table 1 show that the items most frequently sharpened were 'Fitzroy Street', the 'Negro', and the 'Cigarettes'.

Assimilation

By assimilation is meant the way in which items are sharpened and levelled in accordance with the attitudes, interests, habits, and so on, of the individual subjects. Some forms of assimilation are fairly simple, but others suggests deeper needs and prejudices. These experiments provided many examples of both kinds. Following Allport & Postman, we can distinguish the following:

Assimilation to principal theme; 'good continuation'.

Once certain items have been sharpened and provide a setting for the rest of the story, the remaining versions tend to fit the main theme of the story so as to make it more plausible and coherent. Take, for example, the beginning of the 'George and Eva' story, as rendered by Group D.

First version. I was walking past a hotel the other day, and I called in for a drink, and who should I see there but George...a few minutes later Eva came in.

Second version. I was walking down a street the other day past a hotel, so I called in to have a drink, and while I was there I saw George...later on in came Eva.

Third version. I was walking the street the other day when I met George. George was going to have a drink, so I went in with him...we were standing in the pub and George suddenly espied Eva.

Fourth version. I was walking down the street the other day when I met George, and he invited me to come for a drink. When in the pub I met Eva.

Here the story turns from a casual eavesdropping in a hotel lounge to a meeting, an invitation and a drink.

An even more striking example was seen in one of the 'supplementary' experiments which concerned the watching of a fight by a crowd of people in a railway siding. This became contemporized into waiting on a station platform with a fight starting on the platform opposite among a crowd of people waiting for the train. Once 'railway siding' had become 'railway station', the crowd was assimilated into a group of would-be passengers, thus making the story more plausible.

Assimilation by condensation.

Very often instead of two items being remembered, they are fused into one. In the 'George and Eva' story, Eva came in, and later flounced out; several times she is reported as having 'flounced in'. In the Fitzroy story, there were two men looking across the road, and a negro by the lamp-post with his left foot raised; this becomes, in one version of Group B, a group of three negroes, one of whom has his left leg in the air. So too 'six men' becomes a group of men. Very often details at the end of a story were fused with ones from the beginning.

Assimilation to expectation.

Many items become reported as they should be, rather than as they are, or as they might be expected to be, rather than as they have been described. Men waiting outside a cafe, which sold cigarettes becomes men buying cigarettes, and then smoking cigarettes; on one occasion it became 'as there were some women waiting there too, it looked like a cigarette queue' but perhaps that is more accurately described as assimilation to prejudice. In much the same way, in the 'George and Eva' story, the meeting with George and the subsequent going into a pub, becomes an invitation for a drink—for what else could one expect if one meets an 'old friend' outside a public house?[1]

Assimilation to linguistic habits.

Frequently words in the original version were changed in order to fit them in to the subject's more usual speech patterns. The name of the hotel 'Astoria' became assimilated to Liverpool's principal hotel, the 'Adelphi'. 'Twaddle' becomes 'nonsense' or 'claptrap'. 'Fitzroy Street' did not sound quite aristocratic enough, and became 'Fitzroy Square'. 'Vulgar ass' which is what 'Eva' called 'George' was altered by one of Group A (the

[1] One very good example of this emerged as a result of a slip up in experimental procedure; one of the subjects, before leaving the room, had happened to see the back of the picture used originally in the 'Fitzroy' story; the picture on the back was of some African women gathering groundnuts—a cutting from *Picture Post*—and looked little like the legs of bathers at the seaside. Later, this subject remarked to the others waiting outside that she was sure it was a picture of some people *bathing*. It so happened that the sixth subject was an Indian women, whose command of English was good, but not very clear; the subject following her, heard her say 'There was a group of people waiting outside in 'Fitzroy Square', but did not catch it completely; she then remembered what the previous subject had been expecting, and promptly reported that it was a picture of some people *bathing* in Fitzroy Square. This surprising version was not cleared up until the inquisitive subject confessed as to what she had seen.

W.E.A. class) to the more customary lower middle-class 'You vulgar creature'. Social science students sometimes altered negro to 'coloured man', and one referred to men and women as 'males and females'—this can be contrasted with one of the W.E.A. class who spoke of 'ladies and gentlemen'. In the supplementary experiment referred to, the crowd were purposely described as being 'mostly lower class', and this was duly changed, by social science students, into 'working class'. In the same experiment, a woman student replaced the word 'raincoat' by 'mackintosh'. In another supplementary experiment, a lot of out-dated slang was purposely used in describing a motor accident. This was soon transformed into more contemporary jargon. In the same experiment, a large store which in the original was described as 'Hewis's', soon became 'Lewis's', one of Liverpool's largest multiple stores.

One rather strange form of linguistic assimilation was seen in the way in which a word, or a group of words, became altered so that it sounded the same as the original, but meant something quite different—a sort of pun, in fact. Here are the first words of successive versions of Group B's 'Egg' story:

Third version. The picture was a picture of an *Ensa* performance. The people were sitting on seats of the wooden *variety*....

Fourth version. The picture was one of the *Ensa variety.* The audience were sitting on wooden rows of hard seats....

Fifth version. The picture was rather of an *ancient type.* The audience were sitting in rows on rough wooden benches....

Sixth version. This is rather an *ancient type* of picture and the audience is sitting on rough wooden benches....

Seventh version. This seems to be a very *old-fashioned type* of picture. There's a number of people sitting on a rough bench....

Eighth version. This seems to be a very *old-fashioned sort* of picture. A number of people sitting on a rough bench.

Final version. This seems to be an *old-fashioned story*—three people sitting on a bench....

Notice in this, apart from ENSA becoming 'ancient', how the scene is gradually changed from a picture of a concert hall, to an old-fashioned picture (i.e. film) and thence to an old joke—illustrating assimilation to the principal theme.

But perhaps the best example of this 'punning' process is to be seen in the supplementary experiment about the motor crash. The original story contained the following passage:

A car swerved suddenly and hit the back of a tram, just on the corner by Hewis's Store; the building was plastered with notices saying that a sale was on. Perhaps the chap in the car was plastered too—that may have accounted for his swerving, but it had been raining, so he may have skidded.

By the second reproduction, this had become: 'A car skidded round the corner by Lewis's shop which was plastered with notices and the motorist probably had lots of plaster on him too'. This was retained until the fourth version, but the fifth subject reported:

The *car skidded* round Lewis's corner, the windows of which were plastered with notices.

She spoke rather fast, and the next subject gave her version as:

The *casket of jewels* was stolen and the windows of Lewis's were smashed.

As such it remained, until the last subject, rather puzzled, reported that a *basket* of jewelry was stolen.

Another surprising situation developed in the 'Egg' story as told by Group F. The first subject's story read:

...They are sitting round with their coats on, so it must be a coldish evening; one of them is sucking an ice cream, so one imagines that it is summer too.

Second version. ...It is difficult to say whether it is summer or winter because they are wearing coats, *n the one hand*, and eating ice-creams, *on the other*....

Third version. ...You can't tell if it's summer or winter—they've got their fur coats *on one arm and re eating ice creams with the other*....

Assimilation to interest.

It is not easy to detect deeper emotional tendencies, such as underlie gossip and slander, n the laboratory, but on a few occasions certain needs and prejudices were so evident that hey emerged quite clearly. The two main forms were assimilation to interest and assimila- ion to prejudice.

In the 'Fitzroy' story, the second subject of Group D reported that:

None (of the men) were smoking, outside this café, and the café hadn't opened, so it was assumed that hey were waiting there in order to buy some cigarettes....

The third subject was a woman who was a very heavy smoker; subjects were not allowed o smoke during the experiment; and her version became:

Part of the group were people smoking, although there were three who were not smoking. It was presumed hey were waiting outside the café, which was closed, because they wanted to buy some cigarettes.

Assimilation to prejudice.

In the supplementary experiments several attempts were made to get at political rejudices by inserting them to see what changes or omissions took place (these experi- ments were mostly conducted at the time of the last general election) but they were not ery successful. The experiment that dealt with a fight in a railway siding ended:

I wondered why they were not working instead of fighting in the middle of the morning, but I believe here may have been a strike in the yards that day.

This was omitted by the first subject, but he admitted later that he was 'rather touchy n the subject of strikes'.

The 'George and Eva' story provided a better opportunity, for George asked whether Charles had ever seen a business man or a Trade Unionist, and said that he had been alking a lot of political twaddle. In Group B, the first subject omitted any reference to he Trade Unionist, saying later that he had imagined George to have been a die-hard Tory, and a business man to boot.

It is hoped that later experiments will show better ways of getting at deeper attitudes n a more indirect way. One great virtue of this method of studying rumour is that it llows the experimenter to discuss each subject's version with the subject, and to get a etter idea of why he sharpened this item or levelled that, and assimilated others.

VII. Conclusions

The results of these experiments help to confirm the findings of Allport & Postman, in articular with respect to the 'Three-part pattern of distortion', levelling, sharpening and ssimilation, which had been demonstrated by Wulf(8), Gibson(6), Carmichael, Hogan & Valter(5), and above all by Bartlett(4). Certain findings are not totally in agreement with nese previous researches, these are:

(i) The amount of personal involvement in a given story is likely to have some effect n the amount of the story retained, in that more of it will be retained more accurately.

Whereas most rumour-stories become so distorted in the course of successive reproductions that their meaning may be totally different from the original, an ego-involved story tends to preserve most of its meaning throughout. Admittedly, the numbers used in the ego-involvement experiment were small; but it is hoped that further experiments will either substantiate or refute this hypothesis.

(ii) Bartlett states ((4), p. 172): 'In what may be called serial remembering the most unstable elements of all are proper names and titles. This has not been the case in these experiments. It is suggested that the names in the various stories, 'Fitzroy', 'George', 'Eva' and 'Charles', have served as useful 'anchorage points' around which the story is constructed.

One of the main difficulties concerns the reliability of the index of levelling: it is essential, before a rumour-story is used, to decide what the details in it are, how many they are, and what criteria are used to determine them. Only in this way can the number of details produced in successive versions be accurately computed. It is suggested that a measure of reliability be applied to each index of levelling in order to ensure accuracy.

The processes of levelling and sharpening, although providing interesting results, are perhaps less important than the process of assimilation, less important, that is, for psychological theory. For if we compare a rumour experiment with a projection test, such as the Rorschach, or the Thematic Apperception Test, various similarities become apparent. In a projection test, the subject is faced with an unstructured, and probably ambiguous stimulus (e.g. an ink-blot), or a picture, equally ambiguous, in that different interpretations can be read into it by different people. So, too, when a person hears a rumour-story, he is confronted with what may be an ambiguous tale; provided, of course, that it has not been levelled to such an extent that it can be easily memorized. Out of that story, he unconsciously selects some details and neglects others, a process as often as not determined by his own interests and attitudes, in exactly the same way that a person's responses on the Rorschach or TAT story reveal something of his underlying personality structure.

This suggests that a rumour-story might well be a good form of personality test; as Allport & Postman say: 'What does a person do with the story he hears? So long as it has some ambiguity (is not constrained by rigid and readily available evidence), and so long as it has some potential importance in his life, he reacts to it much as does the subject in the projective test situation'((2), p. 146). It is hoped that further experiments may be able to test this point. These experiments give some evidence of the relevance of Gestalt work on perception to the broader field of memory and rumour.

As long ago as 1909, Whipple, writing on testimony and 'the observer as reporter' said:

> The report arises from processes of perception and thereby involves the whole psychology of sensation, attention and apperception; it hinges upon retention and recall, and thereby involves the whole psychology of memory; it issues in verbal statements, and thereby involves the psychology of language and expression; it is conditioned by numerous subjective factors, temperamental tendencies, sentiment, susceptibility to suggestion, etc.[1]

If testimony is a 'field in which a great many psychological interests meet', how much more so is rumour, for in studying a subject's response to a rumour-story one is studying not memory in isolation, but the subject as a whole; by questioning him afterwards one can get clearer insight into his responses.

It is hoped that later experiments along the same lines will clear up some of the points raised in this research; in particular it is hoped that experiments using picture material

[1] Quoted by Allport & Postman ((2), p. 50).

more akin to that used by Murray in the Thematic Apperception Test, will show how far it is possible to detect the more highly motivated forms of assimilation. One such experiment has been performed, in which an actual TAT response was used as the original story; it concerned a husband and wife arguing over the wife's bills. It was noticeable that the men tended to side with the husband and the women with the wife, but as yet it is too early to say how productive a field this particular research is likely to be.

A laboratory rumour is not the same as a real rumour, the whole context is much more artificial; yet the results quoted above show that there are certain similarities between what happens in the laboratory and what happens outside it; we can at least get some indication of why a rumour takes a particular form; we can say fairly accurately what is likely to happen to that rumour as it travels the rounds—we cannot predict exactly what form it will take, but we can estimate its progress in terms of the three-part pattern of distortion. Although we cannot, in the laboratory, always get at the motives which underly gossip and slander, at the various reasons which lie behind the spreading of some particular story, yet we can, even in such a limited experimental situation, provide some insight into why people report what they have seen or heard in so distorted a manner; knowledge which supports what Shakespeare wrote when he spoke of rumour as

> ...a pipe
> Blown by surmises, jealousies, conjectures,
> And of so easy and so plain a stop
> That the blunt monster with uncounted heads,
> The still-discordant wavering multitude,
> Can play upon it.

VIII. Summary

1. Three 'neutral' stories and one 'ego-involved' story were given to six and two groups of subjects respectively. These subjects differed in age and educational standards, and were composed of both men and women.

2. Examination of the results of the 'levelling', 'sharpening' and 'assimilation' that appeared in the stories showed that in the 'ego-involved' story, significantly fewer details were levelled. One of the 'neutral' stories also showed significantly less levelling than the other two.

3. The results are interpreted as confirming the 'Three-part pattern of distortion', and as suggesting that material affecting a person's interests is less likely to suffer distortion than material in which they are not ego-involved.

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A STUDY OF GERMAN AND ENGLISH TEACHER-TRAINING STUDENTS BY MEANS OF PROJECTIVE TECHNIQUES

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I. *Introduction* (p. 56). II. *Subjects of the study* (pp. 56–57). III. *The attitude projection test* (pp. 57–102). IV. *The Group Rorschach Test* (pp. 102–112). V. *Summary of results and conclusions from both tests* (pp. 111–112). VI. *Supplementary material on the attitude test* (pp. 112–113). *References* (p. 113).

I. Introduction

The experiment presented here forms part of a larger investigation into possible differences between reasonably comparable German and English groups of children and young adults. In a previous paper (5) differences which emerged when groups of secondary school boys in Germany and this country were submitted to the same projection test were discussed. The investigation has now been extended in breadth and depth. In Germany and in this country secondary school boys and girls and young adults of both sexes in Teacher Training Colleges have been tested. All of them were given two group tests, a projective attitude test and a group Rorschach, the assumption being that the first one might reveal the environmental influences and the latter the deeper layers of the personality. The two tests would thus be complementary to each other and together might give a fairly full personality picture.

In the present paper some of the results obtained with German and English women teacher-training students in the projective attitude test and in the group Rorschach, free association method, will be presented and discussed.

II. Subjects of the study

For the attitude test each group consisted of 53 subjects; for the Rorschach test there were 23 subjects in each group. The reason for the difference is that while the attitude test was carried out exactly in the same way for all subjects, 23 English and 23 German women then did a group Rorschach, by the free association method, and 30 English and 30 German did the group Rorschach, by the multiple choice method (the results of this are not here reported). The English group of 30 subjects took the attitude and the Rorschach tests a year later than the 23 subjects (1948 and 1949), and the 30 German students were tested in 1948 in two groups and in different colleges. Analysis, however, of the data from the attitude test for both the Germans and the English showed such close similarity between the results of each group of 23 and its corresponding group of 30 that these results were thrown together.

The tests were carried out anonymously, but in each case the subject was asked to put her initials, religion, age, place of birth, and father's occupation on the record sheet. From Tables 1*a* and 1*b* it can be seen that age distribution and family background are fairly similar for the German and the English groups. On the English side all those in group Ew (*a*) and a number in group Ew (*b*) had reached matriculation standard. There were two Roman Catholics in the first and three in the second group and the subjects came from fifteen English counties and from Wales. The Germans either had the 'Mittlere Reife', corresponding to matriculation, or an elementary school education with teacher-training

nterrupted by the war. Most of them had already been teaching but were not allowed to ontinue unless they underwent the 2 years' course. They were non-resident and had to ay 20 Marks monthly for the course. There was one Roman Catholic in group Gw (*a*) and fteen in group Gw (*b*). Data on place of birth indicated that most of the German students ame from the west of Germany, those from the Rhineland and Westphalia being in the ajority.

Table 1*a*. *Age distribution*

	Years		
	21–30	31–40	Total
Ew			
(*a*) '23' group	23	0	
(*b*) '30' group	22	8	
Total	45	8	53
Gw			
(*a*) '23' group	23	0	
(*b*) '30' group	21	9	
Total	44	9	53

Table 1*b*. *Fathers' occupation* (*classification according to Goodenough* (10))

	Professional	Semi-professional and managerial	Clerical, skilled trades, retail business	Farmers	Semi-skilled, minor clerical, minor business	Slightly skilled	Blanks	Total
Ew								
(*a*) '23' group	1	6	11	2	2	0	1	
(*b*) '30' group	5	7	12	1	2	1	2	
Total	6	13	23	3	4	1	3	53
Gw								
(*a*) '23' group	1	5	16	0	1	0	0	
(*b*) '30' group	4	6	16	0	0	4	0	
Total	5	11	32	0	1	4	0	53

The experimental work was undertaken in both countries by the writer. Testing was one in large class-rooms suitable for screen projection. With all groups the Rorschach est followed the attitude test either immediately or within a few hours.

III. The attitude projection test

(*a*) *Method*

he test took 40 minutes. The students were shown the picture of a young woman and ere asked orally a number of questions about her. They wrote down the answers themlves. The questionnaire, with some modifications, and the picture were taken from aven's (8) 'Controlled Projection' test. The woman in the picture is sitting at a table with er back to the onlooker. Whether she is writing, drawing, working or doing nothing is ft to the imagination of the subject. Two questions (5 and 7) were added to the original uestionnaire and a number of questions were shortened or rearranged. The whole produre was adapted for group purposes.

The test was introduced on the following lines:

This is the picture of a young woman. I shall ask you questions about the person in the picture and you e going to write your answers down. Don't stop a long time for thinking. Write down the *first* answer hich comes into your mind.

The questions were as follows:

1. (*a*) What do you imagine the person in the picture might be interested in?
   (*b*) When she stops what she is doing, what will she think?
2. (*a*) What is her real work?
   (*b*) What does she like about her work?
   (*c*) What does she dislike about it?
3. (*a*) Who will see her work?
   (*b*) What will they say?
   (*c*) What will they think?
   (*d*) What will she think?
4. (*a*) What sort of people does she like?
   (*b*) Whose company does she really prefer?
   (*c*) What sort of people does she dislike?
5. One day there was an argument at home.
   (*a*) What was it about?
   (*b*) What happened?
6. (*a*) What annoys her?
   (*b*) What does she do when she is angry?
7. Some time ago she missed an important appointment.
   (*a*) Why?
   (*b*) What did she say?
8. (*a*) What frightens her?
   (*b*) When she gets tired, what worries her?
   (*c*) What does she do?
9. One day she saw or heard something she thought really funny. What was it?
10. She dreams she gets what she wants.
    (*a*) What does she get?
    (*b*) She is given £1000, what does she do?
    (*c*) She wakes and finds she has been dreaming, what does she feel like?
11. (*a*) Is she satisfied with things as they are?
    (*b*) What does she aim at doing?
    (*c*) How does she set about it?
12. (*a*) What do you like about the person you have described?
    (*b*) What do you dislike about her?

(*b*) *Results and discussion*

Question 1.

Tables 2 and 3 show the answers to the first question.

It will be seen that the Gw were more prolific than the Ew and a greater number of them gave more than one answer to the question, but only 15 of these answers concern an interest of the girl which could be inferred directly from the picture, e.g.: 'reading', 'writing'. Their emphasis is on general interests with academic pursuits to the fore. 'Thinking' is frequently mentioned, 'she thinks', 'writes her thoughts down', 'interested in thinking problems through'. More Ew answered with the interest of the moment. Amongst general interests studying is not prominent and the only reading which is specified is a book 'concerning a family's history'.

On stopping work both groups consider the work just accomplished but the attitude in the two groups is reversed. Half of the Ew actively criticize the work done and express satisfaction, dissatisfaction or uncertainty. Only 6 Gw do the same. They tend more to think over what they have done, drift into generalities and some of them land in meta

Table 2. *Qu.* 1 (*a*). *What do you imagine the person on the picture might be interested in?*

English women		Absolute no. of answers	Percentage of total no. of answers
Momentary interests:			
Writing (13), reading (9), drawing (9), study, homework, calculating, etc.		37	62
General interests:			
Academic studies:			
Books, history, literature, mathematics, etc.	6		
Other:			
Walking, sports, athletics, nature, etc.	6		
Art	5		
Crafts	1		
Music	2		
	—	20	33
Specific answer:			
'Reading a book concerning a family's history'		1	1·6
Vague answers:			
Anything, her work		2	3·4
		60	100

German women		Absolute no. of answers	Percentage of total no. of answers
Momentary interest:			
Reading (6), writing (3), drawing (3)	12		
'Intends to write a letter', 'she thinks', 'writes her thoughts down'	3		
	—	15	19
General interests:			
Academic studies:			
Literature (10), science (9), books (3), philosophy (2), maths (2), intellectual work, etc.	29		
Other:			
Sport (7), nature	8		
Music	5		
Art	2		
Needle work, crafts	2		
Dance, fashions	3		
Domestic work	3		
	—	52	65
Specific answers:			
To be a writer, to think problems through, a thought in a scientific work, etc.		8	10
Vague answers:			
Her work, anything a woman is interested in, etc.		5	6
		80	100

(In this and the following tables where the subjects gave more than one answer to a question and the number of answers, therefore, exceeded the number of subjects, percentages were calculated to enable a direct comparison between the groups. The percentages are calculated from the total number of answers given to the question.)

Table 3. *Qu.* 1 (*b*). *When she stops what she is doing, what will she think?*

English women		Absolute no. of answers
Attitude towards work done:		
Active critical:		
Doubts (11), dissatisfied (7), satisfied (6), criticism (2)		26
Passive reflective:		
On content: 'thinks it over', 'relives it', etc.		3
Reaction:		9
Pleased she has finished		
Physical: Take exercise	5	
Meal, tea	4	
'Tired', 'back is sore'	2	
	11	
What next?	3	
Unclassifiable	1	
	53	

German women		Absolute no. of answers
Attitude towards work done:		
Active critical:		
Doubts (3), satisfied (2), criticism (1)		6
Passive reflective:		
On content: thinks it over	11	
General: 'the world is one great puzzle', 'I am glad I am able to understand this wonderful work', etc.	5	
	16	
Reaction:		11
Pleased she has finished		7
What next?	2	
Physical: take exercise	2	
meal	4	
Regrets she has finished		2
Household duties		2
Miscellaneous		2
Blanks		3
		53

hysics: 'How can I grasp the nature of things?' Only 3 Ew show a further preoccupation ith the work after they have finished and there are no transcendental traces.

There is also a difference in the way the same reactions are expressed. The Ew would ay 'I must have some sunshine', 'I will go out and stretch my legs', and the Gw 'I should ke to go for a walk'. The Ew plan a course of action, the Gw reflect on it. Remarks which ake into account that there is also a body and not only a mind, e.g. 'tired', 'back is sore', o not appear in the Gw sets. More Gw raise the question what to do next once one job finished.

uestion 2.

The answers to question 2 are given in Tables 4, 5 and 6.

Sixteen Ew and 29 Gw connected their answer with study, 34 Ew against 22 Gw with ome sort of employment. If one compares these opposed trends with the answers to Qu. 1 ne impression is strengthened that the Ew are more reluctant to identify with the girl in ne picture than are the Gw.

The variety of reasons given for liking or disliking the work is very great in both groups, ut there is a distinct difference in quality. It stands out most clearly if the answers are ivided into those mentioning 'intrinsic' and those mentioning 'extrinsic' qualities. For stance, the 3 Ew who had chosen landwork as 'her real work' said she liked the open-air fe and disliked the monotony. These answers were classified as 'extrinsic'. The Gw who ad chosen 'farm secretary' as her work said she liked 'the link with nature' and disliked iving things reduced to cold figures'. These answers were classified as 'intrinsic'. The w gave 14 'intrinsic' and 32 'extrinsic' reasons for their likes, and 8 'intrinsic' and 39 xtrinsic' reasons for their dislikes. The Gw gave 36 'intrinsic' and 13 'extrinsic' reasons r their likes, 19 'intrinsic' and 23 'extrinsic' for their dislikes.

Although there is on the whole little repetition of reasons given for liking the work, Ew mention in connexion with study the advantage of 'being able to sit down while oing it', whereas the Gw appreciate the exactitude and accuracy of the work. The Ew ates that 'she enjoys having time for reading', the Gw welcomes the opportunity to enetrate more deeply into the nature of things'. In connexion with office work and some her occupations 5 Ew like the contact with people which it affords. This point is only entioned by 1 Gw.

Long hours indoors are disliked by both groups. Otherwise monotonous work seems to be ore displeasing to the Ew, whereas the Gw regret that they cannot 'think out everything the last'. Of the 29 Gw who gave study as the girl's work 5 say that she dislikes 'nothing' d 5 more leave blanks.

uestion 3.

Tables 7–10 give the results.

According to whether study, office work or other work was chosen as the girl's occupation r work will in the main be seen by tutors and teachers or by the chief or some superior. ve Gw do not show the work to anybody...'she worked for herself'.

A favourable comment is the leading answer in both sets. Outright unfavourable ticism appears only in the Ew group. Another type of answer is not concerned with the rk directly but with the girl herself. Here the non-commital and unfavourable remarks number the favourable ones in the Ew set: 'Tries hard', 'Is this the best she can do?'

Table 4. *Qu.* 2(*a*). *What is her real work?*

English women		Absolute no. of answers	German women		Absolute no. of answers
Student:	13		Student:	13	
Writing	3	16	Study (6), intellectual work (6), writing (2), reading (1), drawing (1)	16	29
	—			—	
Office work:			Office work:		
General clerical	16		General clerical	8	
Special (secretary, typist, etc.)	11		Special (secretary, librarian, farm secretary)	3	
	—	27		—	11
Other work:			Other work:		
Teaching (2), factory (1), landwork/gardening (3), authoress		7	Housewife (3), authoress (2), artistic work, handicraft, music, etc.		11
Vague:			Vague:		
'A sedentary occupation', 'looking after herself'		2	'Thinking', 'her profession'		2
'I don't know'		1			—
		—			53
		53			

Table 5. *Qu.* 2 (*b*). *What does she like about her work?*

English women		Absolute no. of answers
Intrinsic reasons	14	
Extrinsic reasons	32	
'Nothing'	4	
Blanks	3	
	—	53

Main reasons given in connexion with
Study:

Able to sit down while doing it (4), interests her (2), educates her, gives ways of self-expression, time for reading, for thinking, everything, etc.

Office work:

Comradeship/meeting different people (5), uniformity/routine (3), the hours (2), sedentary occupation (2), regular income, responsibility, attention to detail, blank or don't know (3), does not like it at all, etc.

Teaching: contact with people
Land work/gardening: open air (3)
Factory work: night classes
Authoress: peaceful and interesting

German women		Absolute no. of answers
Intrinsic reasons	36	
Extrinsic reasons	13	
Blanks	4	
	—	53

Main reasons given in connexion with
Study:

Its exactitude and accuracy (5), clarity/mental effort (3), problems and complexity (2), to think and strive towards a goal, to understand the universe, to penetrate into the truths of life, its purpose, to get an answer to the questions she is concerned with, research, responsibility, etc.

Office work:

Independence and independent work (3), regular hours (2), contact with people, having to think it over intensely

House wife: care of other people (2), cooking and baking
Farm secretary: the link with nature
Authoress: the content, having to do with literature

Table 6. *Qu.* 2(*c*). *What does she dislike about it?*

	English women	Absolute no. of answers
Intrinsic reasons	8	
Extrinsic reasons	39	
Nothing	1	
Everything	1	
Blank	4	53

Main reasons given in connexion with
Study:

No set hours, long hours, lack of exercise, tiring, continuous reading, not enough time to read, slow progress, technical details ,things she cannot do, having to think hard, its claims on her time, etc.

Office work:

Being indoors/sitting still (6), long hours/tied to an office (8), routine/monotony (11), blank (3), everything

Teaching: blank

Landwork/gardening: monotony, routine (3)

Factory: monotony

	German women	Absolute no. of answers
Intrinsic reasons	19	
Extrinsic reasons	23	
Blanks	6	
Nothing	5	53

Main reasons given in connexion with
Study:

Nothing (5), blanks (5), lack of exercise (2), cannot solve all the problems, that she cannot reason it all out, everything which does not seem perfect to her, it takes so long to find solution, its onesidedness, no success sometimes, etc.

Office work:

Long hours indoors (4), restrictions, monotony, nothing

House wife: cleaning and dusting, dirty work

Authoress: the form, blank

Farm secretary: living things reduced into cold figures

Table 7. *Qu.* 3(*a*). *Who will see her work?*

English women	Absolute no. of answers	German women	Absolute no. of answers
Her chief, employer, superior	33	Tutors, teachers	17
Tutors, teachers	12	Her chief, employer, superior	12
The public	3	Friends, people around her	9
Classes she takes, children	2	Nobody	5
Colleagues	1	Colleagues	4
Crowds of people	1	A good friend, people she loves best, a beloved person	3
Nobody	1	The public	2
		Blank	1
	53		53

Table 8. *Qu.* 3(*b*). *What will they say?*

English women		Absolute no. of answers	German women		Absolute no. of answers
Referring to the work directly:			Referring to the work directly:		
(*a*) Favourable: satisfactory (5), good (5), careful (2), conscientious (2), accurate, best of ability, interesting, etc.	22		(*a*) Favourable: conscientious (5), thoughtful (3), thorough (2), exact (2), clear (2), will praise it (2), careful, well structured, etc.	22	
(*b*) Unfavourable: very bad, unsatisfactory, etc.	7		(*b*) Conditional: quite good, much can be improved, looks nice but...	3	
(*c*) Conditional: quite good, reasonably accurate	2		(*c*) Unfavourable	0	
	—	31		—	25
Referring to her as a worker:			Referring to her as a worker:		
Good worker, efficient, will improve, tries hard, could have done better, 'is this the best you could do?', etc.		11	One can rely on her, well-balanced person, strong will of her own, efficient housewife, thinks too much, etc.		13
Referring to neither:			Vague:		
'Thank you' (2), 'at last'		3	Formal remarks, criticism, will praise or blame it, etc.		8
Vague:			Unclassifiable		2
If good..., if bad..., will say whether it is satisfactory or not, etc.		5	'Don't know', blanks (two connected with 'nobody' in Qu. 3*a*)		5
Blank, 'I don't know' (one connected with 'nobody' in (*a*))		3			53
		53			

Table 9. *Qu.* 3 (*c*). *What will they think?*

English women		Absolute no. of answers
Referring to the work directly	10	
Referring to her as a worker	30	
Referring to neither	9	
Vague	3	
Blank	1	
	—	53
'Thinking' same as 'saying'		22
'Thinking' better than 'saying'		6
'Thinking' worse than 'saying'		12
'Thinking' not connected with 'saying': she should go out more, must find her some more work, marking takes a lot of time, I wish I had some brighter students, etc.		9
Vague: depends on the results, etc.		3
Blank (connected with 'nobody' in Qu. 3*a*)		1
		53

German women		Absolute no. of answers
Referring to the work directly	14	
Referring to her as a worker	28	
Referring to neither	2	
Vague	2	
Blanks	7	
	—	53
'Thinking' same as 'saying'		39
'Thinking' better than 'saying'		3
'Thinking' worse than 'saying'		2
Vague: efficient or less efficient		2
Blanks (two connected with 'nobody' in Qu. 3*a*)		7
		53

Table 10. *Qu.* 3(*d*) *What will she think?*

English women		Absolute no. of answers
Glad that she has finished		5
Satisfied with the work done:		
(*a*) Fully: pleased (5), better than expected, good work, etc.	10	
(*b*) Partly: will try harder (3), could have done better (2), done her best but... (2), etc.	11	
(*c*) Uncertain: hopes it is satisfactory, etc.	3	
	—	24
Dissatisfied with the work done:		
Can't do it, lot of trouble for nothing, must read and learn more, etc.		12
Reaction to what 'they say' or 'think':		
Old bear, he does not like me, shall I ask for a rise?, does not care what other people think, etc.		8
Vague: depends on results		2
Blanks		2
		53

German women		Absolute no. of answers
Glad that she has finished		1
Satisfied with the work done:		
(*a*) Fully: glad she managed it (4), satisfied (3), takes pleasure in her work (3), etc.	16	
(*b*) Partly: could still be better (4), has to concentrate still more, etc.	8	
(*c*) Uncertain: hopes it is all right, 'has my work any purpose?', etc.	4	
	—	28
Dissatisfied with the work done:		
Why can't I be better than all the others?, I shall never arrive at an answer to all my questions!, etc.		6
Reaction to what 'they say' or 'think':		
What are they thinking? (2), Am I told the truth?, She does not care, etc.		7
Generalities not connected with the work:		
Thinks of the future, plans to help others, etc.		3
Vague: pleased or disappointed		1
Blanks (one connected with 'nobody' in Qu. 3*a*)		7
		53

All 11 of these answers appraise the girl as a worker, while of the 13 Gw answers which are unconnected with the work directly 6 give judgement on the girl's personality, 'she makes a favourable impression', 'a strong-willed person'. It is obvious that these remarks cannot be made to the girl herself and that they rather represent the impression which those who gave the answers would like to make.

Three Ew answers 'thank you', 'at last', denote a touch of humour and the capacity to objectify the situation. Vague answers and blanks are more numerous in the Gw set.

With very few exceptions the Gw 'thinking' and 'saying' agree. Only 3 Gw make the silent judgement more favourable than the openly expressed one; 2 Gw make it less favourable. Six Ew show that the critic feels more approval than is expressed in the open comment, 12 make the silent criticism more censorious. As the Gw (as Table 8 shows) had given no unfavourable comment the thoughts withheld must either have been in agreement with the comment or less favourable, and the Gw may not have been able to overcome their reluctance to contemplate unfavourable criticism. It may also have been contrary to their principle of truthfulness. Ew answers such as 'if they are honest they will think the same as they say' show that if the situation was taken seriously the principle was the same, but it seems that the 18 Ew students who let the thinking differ from the saying may have seen the opportunity to derive some fun from the answer. The farmer says to the land girl 'you must be quicker or the harvest will be here and you will not have finished', and he thinks 'women work better on the land than I should have thought'. The tutor comments 'very interesting' and thinks 'rather rambling and not always to the point'. Nine Ew did not connect the 'thinking' with the 'saying' at all. These answers have no parallels in the Gw group. Most of them are undoubtedly given with a smile; an answer expressing the thought of a tutor 'this marking takes a lot of time' shows the ability to see the situation from the other person's point of view, and to change the identification from the girl in the picture and her work to the tutor who sees her work.

The Gw blanks go up to 7, only 2 of which are given by students who let the girl show her work to nobody. It seems from Table 9 that the Gw have either spent themselves or are not at ease. To those who take the question too seriously it may seem cynical.

A greater number of Ew either feel pleased that they have finished or are dissatisfied with their achievement, thinking that they will have to try harder. The Gw conscience in that respect is clear, they express more satisfaction with the work done, and dissatisfaction is not directed against their own achievement but instead takes a metaphysical turn 'I shall never find the answer to all my questions'.

Question 4.

The results are given in Tables 11–13.

The number of qualities mentioned varies in the individual answer from one to six. In reading through the two sets the impression one gains is that the Ew stress qualities and attitudes which need a social environment and human relations to come into full play and be appreciated, while the Gw are mainly concerned with mental and moral qualities and with attitudes to life which frequently could be exercized in solitude. The traits are by no means antithetical or mutually exclusive, but they seem to be related to a different aspect of personality; the Ew emphasize the social, the Gw the intellectual and ethical aspects.

To the question 'whose company does she really prefer?' 10 Ew gave the somewha

Table 11. *Qu.* 4(*a*). *What sort of people does she like?*

English women		Absolute no. of answers
Social qualities and attitudes	*c.* 57	
Mental and moral qualities and attitudes	*c.* 33	
Physical qualities	7	
Vague	7	
Total number of qualities mentioned	104	
Qualities most frequently mentioned:		
Friendly (7), humorous/sense of humour/touch of wit (5), straight/sincere (5), energetic/active/sociable/entertaining (8), quiet (7), studious (4), thoughtful (3), who likes books/music/arts (4), intellectuals (3)		
Social traits and attitudes mentioned alone:		
Interested in the world in general; easy-going, untemperamental; entertaining and amusing; friendly, active, open-airish, etc.		27
Mental and moral traits and attitudes mentioned alone:		
Studious, quiet, interested in books; who think about life and wonder; artistic and intellectual, etc.		11
Social and mental traits mentioned together:		
Companionable, sensible, intelligent; humorous; homely with imagination; studious, fond of books, good at discussions, with sense of humour, etc.		8
Vague:		
Most people, with the same tastes, all sorts of people, etc.		7
		53

German women		Absolute no. of answers
Social qualities and attitudes	*c.* 17	
Mental and moral qualities and attitudes	*c.* 63	
Physical qualities	7	
Vague	8	
Total number of qualities mentioned	95	
Qualities most frequently mentioned:		
Open/truthful/sincere/honest/having integrity/straightforward (14), realistic (4), cheerful/natural (4), who like home-life (2), quiet/calm/poised/reserved (10), who like books (3), art (4), nature (2), clear thinking/deep (5), inward (3), scientifically minded (3)		
Social traits and attitudes mentioned alone:		
Open, unsophisticated, cheerful; domesticated, sociable, who like sport, etc.		5
Mental and moral traits and attitudes mentioned alone:		
Cultured people, interested in literature, having an inner life; deep thinking, introspective with inner cheerfulness, fond of books, nature, music; hard working, gifted; quiet, intellectual, etc.		29
Social and mental traits mentioned together:		
Straightforward, open, ready to fight for their opinion; thoughtful, problematic, proud, energetic; interested in sport, books, theatre; artists and kind people, etc.		11
Vague:		
Unusual people, like her, congenial, etc.		8
		53

Table 12. *Qu.* 4(*b*). *Whose company does she really prefer?*

English women		Absolute no. of answers	German women		Absolute no. of answers
One person:			One person:		
Someone: understanding friend, similar to herself, she is very fond of, not a crowd		5	Man	4	
			Woman	4	
			Someone	2	10
			Man she loves, man sharing her interest, older woman, girl same age, etc.		
More than one:			More than one:		
Men	9		Men	4	
Women	2		Women	3	
Mixed	5		Family	2	
Family	1		Mixed	1	
Children	2		Children	1	
Not specified	15	34	Not specified	30	41
Qualities mentioned:			Qualities mentioned:		
Own age (2), with same tastes (2), like herself, older than herself, unbiased, practical, unconventional, interested in literature and arts, people she knows well, people known at home, etc. (no qualities mentioned by 16 subjects)		10	Like-minded (10), intelligent (4), high intellectual level (2), intellectually superior to her (2), from whom she can learn (2), of same interests/age, quiet, serious, mature, warm, etc. (no qualities mentioned by 4 subjects)		
Her own		1	Likes being alone	1	
Animals			Her books	1	2
Vague:					
Husband if married, family if not; boy friend if she has one		2			
Blank		1			
		53			53

Table 13. *Qu.* 4(*c*). *What sort of people does she dislike?*

English women		Absolute no. of answers
Social qualities and attitudes	*c.* 59	
Mental and moral qualities and attitudes	*c.* 32	
Vague	2	
Unclassifiable	3	
Total number of qualities mentioned	96	
Qualities most frequently mentioned:		
Noisy (6), domineering/overbearing/who assert themselves too much/dogmatic (7), boastful/pompous/officious/bustling (4), unkind/mean/sophisticated (6), not sincere (2), mean (2), narrow-minded (3), superficial (1)		
Social traits and attitudes mentioned alone:		
Pompous, no adaptability and understanding; who assert themselves too much, overbearing with too high an opinion of themselves; who speak ill of people, etc.		26
Mental and moral traits and attitudes mentioned alone:		
Narrow-minded, no sense of proportion; inconsistent and making no effort; who will not attempt anything they know will not be successful; cold-hearted; no principles, no decent code, etc.		14
Social and mental traits mentioned together:		
Noisy ones who speak without thinking; narrow-minded, jealous; mean, snobbish, cruel, impatient, dishonest; noisy, emotional, etc.		8
Vague:		
Rivals, superior to her intellectually		2
Unclassifiable		3
		53

German women		Absolute no. of answers
Social qualities and attitudes	*c.* 28	
Mental and moral qualities and attitudes	*c.* 61	
Blank	1	
Total number of qualities mentioned	90	
Qualities most frequently mentioned:		
Noisy (7), restless (4), assertive/dogmatic/domineering (4), superficial/shallow/empty (13), muddled thinkers (5), untidy (5), sentimental/highly strung/over-emotional (5), materialists/cold/governed by reason/unfeeling/indifferent (6)		
Social traits and attitudes mentioned alone:		
Noisy, overbearing; who boast and swank; who like lamenting; bluffers, etc.		13
Mental and moral traits and attitudes mentioned alone:		
Cold, unfeeling, governed by reason; sentimental, over-emotional; illogical; who do not know what they want; who run behind material values; who work without thinking; dependent, superficial, etc.		29
Social and mental traits and attitudes mentioned together:		
Dishonest, flattering, slovenly; illogical, silly talkers, dogmatic; without imagination, despotic, etc.		10
Blank		1
		53

puzzling answer 'her own'. It is a slick repartee and one may perhaps assume that it was meant as an easy joke, the more so as this mass withdrawal would be in complete disagreement with all the other Ew test reactions. It is, however, possible that a reaction against the claims of community life is here expressed.

Otherwise, there are no great differences between the two groups. The Gw show a slight tendency to prefer one person's company, the Ew mention more frequently men and mixed company. The Gw mention 'intellectuals' and 'intellectually superior to her from whom she can learn'. Own age, same tastes and like-mindedness are vague answers which appear in both groups.

Question 5.

Tables 14 and 15 give the results.

The majority of arguments arise about the girl herself. In the Gw home overworking and being too conscientious cause most trouble. The Ew bring in a greater number of disputes not connected with the girl and they are more precise in stating the causes, e.g., 'who should prepare the tea', 'parents bickering'. Religion, politics, intellectual and ethical issues are mentioned by the same number of students (11) on both sides.

A slightly greater number of Gw than of Ew get their own way, but while on the Gw side, with one exception, this is achieved by disregarding the other's view, half of the Ew win by persuasion. The Ew both give in and reach agreement more frequently; they realize they were wrong, or both parties see the other's point of view. Thirteen Ew and 15 Gw do not come to a definite solution, but while the Ew agree to differ or forget about it, 8 of the Gw either let the girl withdraw or stick to her point of view. There are 5 blanks on the Gw side.

Question 6.

Tables 16 and 17 give the results.

The two main causes of annoyance are other people's behaviour or qualities, and interference. Purely environmental disturbances, with noise holding first place, are more frequently mentioned by the Ew, while more Gw let the girl resent interference with her person and personal affairs. Bad manners, selfish behaviour and fussiness annoy the Ew more than anything else. Untidiness, unpunctuality and failure to keep promises are more irritating to the Gw. Many more Gw than Ew mention personal difficulties, the main complaint being 'not being understood'. It is instructive to see how the same cause of annoyance is differently expressed in the two groups: the Ew states 'that people cannot see her point of view', and the Gw says 'unwillingness to consider her opinion', the emphasis being on inability and lack of good will respectively.

On the whole anger finds release amongst the Ew but no open expression amongst the Gw. In both groups release takes either the form of immediate direct expression in the presence of the people who caused the anger, 'speaks her mind', 'flares up', or the balance is restored indirectly by physical or mental means 'going for a walk', 'working harder'. The suppression of anger is not only almost 30% higher in the Gw group but more than half of the Gw doing so withdraw bodily from the place of conflict (19 Gw). Only 2 Ew mention that she leaves the room. Some information about what happens when the Gw has withdrawn from company may be gained from remarks such as 'tries to cope inwardly' '. . . and thinks the incident over'. A brooding attitude seems to be taken up. A few Ew

Table 14. *Qu.*5. *One day there was an argument at home.* (*a*). *What was it about?*

English women		Absolute no. of answers
About herself:		
Connected with her work: not giving enough domestic help (3), worked too hard (2), not mixing enough (3), late hours, course of study	10	
Going out too much (2), coming home late, not taking life seriously enough, etc.	5	
Wanting to leave home/change employment (4), she should become independent	5	
Friends not approved of	3	
Too many clothes, her political views, etc.	5	
	—	28
Family affairs:		
Who should prepare tea/coffee/joint, holidays, leisure time, theatre, money, father too much out, parents bickering, etc.		12
General issues:		
Religion (4), politics (2), intolerance, moral standards, etc.		11
Blanks		2
		53

German women		Absolute no. of answers
About herself:		
Connected with her work: too withdrawn (5), over-working (7), too conscientious/too much of an idealist (3), the choice of her career (3), her future, domestic duties	20	
Her independence (3), strong views, she asked for her rights	5	
Friends not approved of	2	
Too much interested in sport, being too superficial	2	
Her peculiarities, etc.	3	
	—	32
Family affairs:		
Vague: family affairs, trifles, something which had to be bought	3	
Upbringing of the children, position of the furniture, etc.	4	
	—	7
General issues:		
Religion (4), politics (1), outlook on life (2), intellectual problems (2), books (2)		11
Blanks		3
		53

Table 15. *Qu.*5(*b*). *What happened?*

English women		Absolute no. of answers
Violent issues:		
Left the house (3), lost their tempers, all upset, everyone shouted, etc.		8
Winning the argument:		
By disregarding the other's view	5	
By persuasion	5	
	—	10
Losing the argument, told off		2
Giving in:		
Realizing she was wrong	9	
To keep peace	1	
	—	10
Agreement:		
Both seeing the other's view	8	
By compromise	1	
	—	9
No issue:		
Agreed to differ (2), forgot it (3), deadlock (1), strained atmosphere, no one gained anything, issue not forced, etc.		13
Blank		1
		53

German women		Absolute no. of answers
Violent issues:		
Left home (4), walked out (2), parted in anger (2), violent quarrel (2)		10
Winning the argument:		
By disregarding the other's view	12	
By persuasion	1	
	—	13
Giving in:		
Realizing she was wrong	4	
To keep peace	2	
	—	6
Agreement:		
Both seeing the other's view	2	
By compromise	1	
'They agreed'	1	
	—	4
No issue:		
She withdrew (into her room, into herself)	4	
Sticks to her point of view	4	
Agreed to differ	2	
Discussion, nothing, etc.	5	
	—	15
Blanks		5
		53

Table 16. *Qu.* 6 (*a*). *What annoys her?*

English women	Absolute no. of answers	Percentage of total no. of answers
Interference		
Environmental:		
Wireless (3), noise (5), being interrupted when busy	9	14
Personal:		
Not having her own way, people who disapprove of her ways, unreasonable interference with her opinions, etc.	7	11
Qualities in other people:		
Bad manners (5), selfishness (4), unnatural fuss and unnecessary complaints (4), incompetence (2), silliness (2), untidiness (1), people being late (1), insincerity, stubbornness, conceit, nosiness, petty grumbling, etc.	40	61·5
Personal difficulties:		
Frustration, that people cannot see her point of view, not finding things when she wants them	3	4·5
Arguments	3	4·5
Housework	2	3
Vague: 'small things'	1	1·5
	65	100

German women	Absolute no. of answers	Percentage of total no. of answers
Interference		
Environmental:		
Noise (2), being disturbed in her work (2)	4	5·7
Personal:		
Interference with her affairs (3), being pampered/being treated too much like a child (2), people who interfere with her inner life, many questions, people too much concerned with her person, somebody obtruding his point of view on her, etc.	11	15·5
Qualities in other people:		
Untidiness (8), people not keeping their promises (3), people being late (3), dishonesty (2), extravagance (2), quarrelsome people (2), vulgar, inconsiderate, superficial people, swayed by mass opinion, violating the right, etc.	35	49·3
Personal difficulties:		
Not being understood (3), boredom (2), that she cannot change herself, her own shortcomings, unwillingness to consider her opinion, that she cannot convince her father in discussing scientific matters, etc.	14	19·7
Shortage of goods, daily struggle	2	2·8
Arguments	2	2·8
Vague: 'trifles'	1	1·4
'Nothing'	1	1·4
Blank	1	1·4
	71	100

Table 17. *Qu.* 6 (*b*). *What does she do when she is angry?*

English women		Absolute no. of answers
Release		
Direct:		
Speaks her mind	5	
Shouts, shouts then cries, shouts and must always tell someone	3	
Loses her temper	5	
Makes sarcastic remarks	2	
Slams the door	1	
	—	16
Indirect:		
Goes for a walk (7), works harder (2), moves furniture, makes a lot of noise, etc.	13	
	—	29
Anger not released:		
Sulks (4), keeps quiet (7), controls it (4), feels sick, feels sense of injustice, just feels angry, counts ten	19	
Withdrawal: keeps quiet and leaves the room	1	
	—	20
Either...or:		
'Either keeps quiet or loses her temper', sometimes manages to keep her temper but occasionally 'flares up', etc.		4
		53
Physical concomitants of anger mentioned 5 times		
Feelings described 4 times		

German women		Absolute no. of answers
Release		
Direct:		
Speaks her mind	3	
Flares up	3	
Gets excited	2	
Slams the door	1	
	—	9
Indirect:		
Goes for a walk (5), plays music, digs herself into her work, writes an excited letter	8	
	—	17
Anger not released:		
Keeps quiet (4), bottles it up, controls herself, tries to keep it to herself, counts ten, sulks, gets stubborn, gets cheerless and unhappy, etc.	16	
Withdrawal: withdraws (6), into her room, from company, with her books, into herself, locks herself in, etc.	19	
	—	35
Blank		1
		53
Feelings described 3 times		
No physical concomitants		

o volunteer some supplementary information: '...and forgets as quickly as possible', els wretched'. The physical concomitants of anger 'loses colour', 'gets pink', 'feels k', are mentioned by 5 Ew and no Gw. These after-thoughts on both sides show once ain the difference in approach. The Ew emphasis is stronger on their own physical and notional reaction, the Gw interest perseverates on the incident itself. 'Either...or' swers in which the subject apparently is aware of the fact that she cannot always trust r control were only given by Ew, e.g. 'either keeps quiet or loses her temper'.

Overlapping between the two groups must, however, not be forgotten, and an answer unts ten' given by one Ew and one Gw reveals how much similarity in upbringing and reaction there may be between single individuals.

estion 7.

Tables 18 and 19 give the results.

This question was added to the questionnaire in the hope that the choice of incidents and e way of handling their consequences might give some indication as to whether shortnings were easily accepted and whether the blame for mishaps was put on the self or the outside world. This expectation was fulfilled for the Ew group but the majority of e Gw group apparently gave a slightly different meaning to the question, thus invalidating a certain extent the results of a direct comparison. It is true that the German word 'appointment' ('Verabredung') has a wider connotation and can be taken as meaning t a date with a friend, but this certainly does not apply when the adjective 'important' added ('wichtige Verabredung'). Two Gw reacted strongly 'I can't imagine that she l miss an important appointment', '...only illness or accident could make her miss it', ich indicates that they construed the question as it was intended. Most of the Gw, wever, disregarded the 'important' altogether and may have had a date with a friend the back of their mind as can be gathered from the wording of what 'she' said to explain y she missed the appointment. Was it so utterly impossible to conceive that an imporit appointment could be missed that the importance had to be belittled? The Gw had wn in their answers to Qu. 6 that 'being late' and 'not keeping promises' belonged to e qualities they disliked, and a negative reaction to an imputation involving these alities could perhaps be expected. Whatever the reasons, in viewing the results, it has be borne in mind that varied importance was attached to the missed appointnt.

A great difference appears in the number of answers admitting some negligence on the l's part. Here the Ew supply 22 examples, the Gw 4. The Ew variety of reasons small, either she missed the bus or she forgot about it, or she was late. No attempt made to avoid responsibility, the girl takes the full blame on herself. The high idence of these themes suggests that they correspond to life experience, and that not serious a stain is attached to them. One may further infer that there is readiness to me oneself for shortcomings. Amongst the 4 corresponding Gw answers 2 let the girl ss the train without comment, one is so overcome by her negligence that she formulates answer 'allowed herself to be kept back by some trifle', and only the fourth states ntly 'slow in dressing'. Considering these figures in the light of the slighter importance ached to the appointment by some of the Gw it might be permissible to assume that l they taken it more seriously they would hardly have given more answers confessing ligence. The 4 Gw answers can, therefore, be accepted as the maximum number. From

Table 18. *Qu.*7. *Some time ago she missed an important appointment.* (*a*). *Why?*

English women		Absolute no. of answers	German women		Absolute no. of answers
Work:			Work:		
Kept back by work/kept late (3), kept by somebody in authority (3), something of greater importance had to be done	7		Kept back by work/kept late at work (12), too dutiful/ conscientious (2), 'work' (4), something more important had to be done first (2)	20	
Absorbed in her work forgot it	1		Absorbed in her work (8), absorbed in her work forgot time (3)	11	
	—	8		—	31
External circumstances:			External circumstances:		
Illness (5), bus late/bus full up (3), something unforeseen occurred (2), ladder in stocking		11	Illness (2), something else cropped up (2), by no fault of hers/train did not go (2), letter came too late, watch was slow		8
Deliberately:			Deliberately:		
Could not make up her mind (2), did not want to go (2), did not think it worth while (2), bad temper, fear		8	No longer interested, books more important to her, reading a good book, lecture interested her more, did not feel disposed, fear of disappointment, doubts, perhaps as a protest against having to		8
Negligence:			Negligence:		
Forgot about it/forgot time (8), missed the bus/connexion/ train (10), got up too late/being late (4)		22	Missed the train (2), slow in dressing, allowed herself to be kept back by some trifles		4
'She wouldn't'		1	'She does not miss an important appointment...', 'can't imagine she will miss an important appointment'		2
Unclassifiable		3			—
		53			53

Table 19. *Qu.* 7 (*b*). *What did she say?*

Reason why the appointment was missed	English women							German women						
	Work							Work						
	Outside control	Within control	Extern. circum.	Deliber-ately	Negli-gence	Does not miss it	Sum	Outside control	Within control	Extern. circum.	Deliber-ately	Negli-gence	Does not miss it	Sum
Apologies only	2	1	.	.	3	.	6	3	1	3	1	.	.	8
Stating facts only	2	.	1	1	2	.	6	6	6	3	1	1	.	17
Facts and apologies	.	.	4	.	6	.	10	6	1	1	1	.	1	10
Reform	.	.	.	.	3	.	3	.	1	.	.	1	.	2
Reform and apologies	.	.	.	1	.	.	1	.	.	.	1	.	.	1
'Unavoidable'	1	.	1	.	.	.	2	.	1	.	.	.	.	1
'Unavoidable' and apologies	1	.	2	.	.	.	3	1	.	.	.	.	.	1
Guilt feelings	.	.	1	.	1	.	2	.	1	.	.	.	.	1
Guilt feelings and apologies	.	.	.	.	2	.	2	.	.	.	.	.	.	.
Making excuses	.	.	.	2	2	.	4	.	.	.	1	1	.	2
Rationalization	.	.	.	4	.	.	4	.	.	.	1	.	.	1
Does not care	.	.	.	.	3	.	3	1	.	.	.	1	.	2
Keeps silent	.	.	.	.	.	.	.	.	.	1	2	.	.	3
Sorry for herself	.	.	.	.	.	.	.	3	.	.	.	.	.	3
Apologies and hopes for other appointment	1	.	2	.	.	.	3	.	.	.	.	.	.	.
Blank	.	.	.	.	.	1	1	.	.	.	.	.	1	1
Unclassifiable (3)	.	.	.	.	.	.	3	.	.	.	.	.	.	.
3	7	1	11	8	22	1	53	20	11	8	8	4	2	53

the low incidence one may infer that missing an appointment through negligence is view much more seriously by the Gw than by the Ew.

Another remarkable difference appears in the answers where 'work' is given as reason for missing the appointment. It is given by 31 Gw, of which 20 put the blame the work itself, 'kept late' or simply 'work'. Eleven Gw state that they were absorbed their work. Only 8 Ew mention work, one of them being so engrossed that she forgot appointment. External circumstances outside the individual's control—*force majeur* such as illness, 'the train did not go', appear in almost equal numbers on both sid Deliberate missing of the appointment appears in equal numbers in both groups (8), reason given being much the same.

It seems clear that 'work' is the most acceptable Gw excuse, and that the readiness admit fault is not as great amongst the Gw as amongst the Ew.

In answer to the question 'what did she say?' to offer apologies or to state facts or to both are the most frequent reactions in both groups, but while the Ew tend both to st the facts and to apologize, the Gw show a definite inclination to state the facts only this takes in a number of cases the laconic form 'the truth'. It seems that a question wh suggests the possibility of an aberration from the truth is resented. If one analyses data still further it seems that the highest incidence of 'facts only' is connected w missing the appointment through being absorbed in work and that the attitude taken is that of 'my work comes first'. Whether this attitude is so generally accepted that excu are deemed superfluous and the disappointed partner's understanding can be taken granted, or whether it is rather a perhaps unconscious tactic of 'qui s'excuse, s'accu would be in need of further investigation.

The incidence of answers not keeping strictly to the truth is very low on both sides

Question 8.

Tables 20–22 give the results.

Twelve Gw protested 'fear is unknown to her', 3 more left blanks. The Ew rejecti 'nothing very much' sound less heroic. The question obviously aroused stronger feeli in the Gw, and the indication is that in the German culture pattern the emotion of and its expression have a different significance. The clinical implication of the rejecti is opposition and rigidity. This shows clearly in an answer such as 'fears nothing exc her own devil and illness' which, although given by a different individual, reveals same mental processes as 'she does not miss an important appointment—only acciden illness could make her miss it'. First, the possibility is emphatically denied and then possibilities are given. A more flexible and less oppositional mind would omit the ref tion altogether or state it as an after-thought only. Within the test situation the rejecti indicate that there is identification. The girl in the picture has assumed a strong posi valence and cannot easily be vested with anything but acceptable qualities. It is aln unthinkable that she should be afraid of mice and spiders, and the only two physical f mentioned are big crowds and darkness. Against this, 24 Ew mention living creatures body sensations and, since many give more than one cause of anxiety, the list of phy fears has 38 items. They all suggest a distinct physical reactivity, e.g. 'anything flap around her face', 'anything with feathers', 'bitten nails'.

Illness and accidents, loneliness and losing a beloved person, and thwarting of ambit are feared on both sides. The mental causes for being frightened can be divided into

Table 20. *Qu.* 8(*a*). *What frightens her?*

English women		Absolute no. of answers	Percentage of total no. of answers
Physical fears:			
Bodily harm:			
Accidents (4), illness (2)	6		
Living creatures and body sensations:			
Spiders (6), heights (4), traffic (3), mice (2), water (2), driving fast (2), sudden noises (2), anything with feathers, thunderstorm, moths, snakes, bitten nails, etc.	32		
	—	38	58
Mental fears:			
Passive states:			
Loneliness/losing someone she loves (5), insecurity (2)	7		
She being passive, others acting:			
Attitudes of others to her, being misunderstood/criticized by employer, appearing ridiculous	4		
She having to act:			
Doing things on her own, performing in front of others, fear of letting people down, having to do things she knows she is not good at, etc.	8		
	—	19	29
General fears:			
Material:			
Lot of argument, bad temper, etc.	3		
Spiritual:			
The supernatural, the occult, etc.	4		
	—	7	10
'Nothing very much', 'very little'		2	3
		66	100

German women		Absolute no. of answers	Percentage of total no. of answers
Physical fears:			
Bodily harm:			
Illness (2), death, accident	4		
Sensations:			
A big crowd, darkness	2		
	—	6	11
Mental fears:			
Passive states:			
Loneliness/losing person nearest to her (3), spiritual disappointment, consequences of overdoing the work (2), to be unhappy in married life	6		
She being passive, others acting:			
Callous people/bad people (2), that her husband/friend may leave her (3), criticism, etc.	12		
She having to act:			
Vital decisions (2), a foolish step, not to be able to take part in a discussion, deteriorating in efficiency, etc.	6		
	—	24	43
General fears:			
Material:			
Her exam. (5), war (2), arguments (2), financial worries (2)		11	20
'She is not frightened', 'fears nothing except her own devil and illness', 'is she really frightened?' etc.		12	21
Blanks		3	5
		56	100

of actions others may take while she herself is passive, and fear of action which she would have to take herself. It seems that there is a tendency amongst the Gw towards passivity whereas more of the Ew are afraid of their own shortcomings and their own activities or their consequences.

The worries show much agreement. Both groups complain about the effort to keep awake and the inability to carry on any longer, both have the unfinished work very much on their minds. Both are assailed by depressive thoughts, but the Gw worries seem to be of a more serious nature. They all reflect a grim struggle for maintenance. The Ew's leading worry this time is 'the work'. One wonders whether an uneasy feeling that they are not working to the best of their ability, which is usually suppressed, comes to the surface in a state of tiredness. Irritability expressing itself in over-sensitivity to noise and people is mentioned by 5 Ew and by no Gw.

When with the work piling up it becomes an effort to keep her eyes open and depressive thoughts obtrude, what does she do? The Ew take a sedative, the Gw a stimulant. Thirty-six Ew seem to think that a good rest either through sleep or relaxation is the best way of coping with the difficulties. 'Does not try to work' characterizes the situation. Ten Gw also believe in sleep but while apparently the Ew has a bath, takes aspirins and goes to bed early, the Gw sets the alarm clock and goes to bed with the firm intention of being fresh early next morning for more work. Twenty-two Gw fight sleep mostly by drinking strong coffee and working still harder. More Gw than Ew (11:4) are unable to stop worrying.

It is certain that the Ew and Gw views on how best to combat tiredness and on the rôle assigned to the body differ widely.

Question 9.

Table 23 gives the results.

The word 'funny' ('komisch') is ambiguous in both languages. The dictionary definition is 'full of fun; droll: perplexing, odd'. The word-combination 'really funny' (wirklich komisch) shifts the meaning towards 'amusing'. No Ew reacted to funny in the sense of 'perplexing, odd' but a fair number of Gw seem to have done so, otherwise their extremely puzzling answers would be completely incomprehensible.

To answer the question quickly needs a considerable alertness of mind. It is, therefore, not surprising to find a record number of blanks. The Ew give 4 blanks and 8 vague answers (e.g. unspecified films). The vague answers are near misses but slightly better than blanks in so far as they show an escape from complete blocking. On the Gw side 11 blanks and 5 vague answers represent the highest number for any of the questions.

Although from the list of things which were thought funny it was obvious that they differed greatly in essence it was by no means clear where the difference lay. It eventually seemed that in one group of answers amusement or perplexity were derived primarily from incidents appreciated through sense perception, that in another group the appreciation was purely intellectual, and that there was a group in between the two. Visual perception is mainly used and the fun lies in the incongruity of the sight itself: 'a fat policeman running behind a small boy'. Apart from 8 specified films, plays and cartoons there are 23 such incidents in the Ew set. All of them depict extremely lively scenes with people or animals moving about, running, dropping things. The Gw have 8 perceptual answers but the full life situation is only recorded in 2 of them, in the others all activity

Table 21. *Qu.* 8(*b*). *When she gets tired what worries her?*

English women	Absolute no. of answers
Physical tiredness:	
Effort of having to keep awake, inability to think properly/ to cope with work, lack of energy to complete a little job, etc.	6
Unfinished work:	
All the work still to be done, pressure of work piling up, things she will have to do to-morrow, etc.	12
Depressive thoughts:	
About her work (7), health (4), money (3), future (2), old age and loneliness (2), her lack of liveliness, etc.	28
Irritability:	
Noise, people round about, dirtiness, etc.	5
'She never worries when she is tired', 'nothing'	2
	53

German women	Absolute no. of answers
Physical tiredness:	
That she may fall asleep, not be able to sleep, that she may oversleep, achieving too little, not to be able to carry out what she intended to, etc.	7
Unfinished work:	
Work still to be done, not quite finished her task, not done her day's work, etc.	16
Depressive thoughts:	
The future/money (9), whether she will be able to reach her goal (3), food (2), whether her health will stand the strain (2), the coming winter, family conditions (2), being a bore, if all people can lie down in peace, etc.	24
Practical things	3
Fighting tiredness:	
'This can't go on, I have to do some more work', etc.	2
'Nothing'	1
	53

Table 22. *Qu.* 8(*c*). *What does she do?*

English women		Absolute no. of answers
Stops working:		
Rest:		
Goes to sleep/to bed/to bed early/after bath/with bottle and aspirin, takes sleeping tablets, asks doctor for bromide, tries to take sufficient rest	22	
Relaxation:		
Some diversion, reading, walking, games, music, visits friends, talks a great deal of trivial conversation, does not try to work, has a hot bath and a beauty session, etc.	14	
	—	36
Short rest:		
Has a rest then starts on work again, etc.		2
Continues to work:		
Tries to do it but does not do it well, exerts self-control, spends overtime on it, etc.		6
Daydreaming:		
About wonderful future (2), something pleasant		3
Continues to worry:		
Keeps going over them in her mind, etc.		4
Unclassifiable (1), 'nothing' (1)		2
		53

German women		Absolute no. of answers
Stops working:		
Rest:		
Goes to bed, tries to sleep, falls asleep over her work, sets the alarm clock, sleeps to be fresh next morning for more work, etc.	10	
Relaxation:		
Reads, tries to divert herself	2	
	—	12
Short rest:		
Sleeps a moment, short rest then continues to work, etc.		4
Continues to work:		
Tries to overcome her tiredness/to keep awake/fights sleep (7), takes a stimulant/drinks strong coffee (8), freshens herself up, works still harder, etc.		18
Daydreaming:		1
Continues to worry:		
Ponders (6), thinks over her day's work critically, brings the misery of mankind to God the Father, etc.		11
Unclassifiable (connected with 'depressive thoughts in (*b*)')		5
Blanks		2
		53

Table 23. *Qu.* 9. *One day she saw or heard something she thought really funny. What was it?*

English women		Absolute no. of answers
Appreciated through perception:		
Films, plays, cartoons:		
Specified	8	
Unspecified	7	
	—	15
Ridiculous or incongruous sights of people:		
Students doing P.T., friend running away from cow, fat policeman running behind small boy, somebody dropping tray in restaurant, etc.		17
Children and animals:		
She herself imitated by little boy, donkey 'shopping' in village street, etc.		6
Appreciated mainly intellectually:		
Person doing what she preached against, an impersonation, a memorandum in bad English composed by her chief, etc.		5
Appreciated intellectually only:		
A clever use of words		1
Children's sayings		3
Vague and unclassifiable		2
Blanks		4
		53

German women		Absolute no. of answers
Appreciated through perception:		
A comedian (2), a picture (2), a film unspecified		5
Ridiculous or incongruous sights of people:		
A woman in the new look, a friend who dressed up against her habit, a woman motor-cycling over a rope, a gifted young man made a funny impression on her, etc.		7
Animals:		
Hens running to trough with loud noise		1
Appreciated mainly intellectually:		
An offer for a job to India, a stranger proposed, a fortune-teller told her she was to marry soon, suicide of somebody she knew (2), her chief married his new secretary, etc.		14
Appreciated intellectually only:		
Something in a book	2	
That some people are only interested in pleasure (2), a discussion on human freedom, politics, that there was to be real peace embracing all nations, a strange point of view, etc.	11	
	—	13
Unclassifiable		2
Blanks		11
		53

is missing 'a woman in the new look', 'a strangely clad person', 'an excited crowd (no verbs!). It is likely that they had a general situation in mind rather than a specific incident.

In the group mid-way between perception and intellectual appreciation there is still a concrete life situation with people as actors, yet the reason why it is thought to be funny is not visible to the eye, it lies rather in circumstances surrounding the particular situation and can only be fully appreciated by the initiated. The Ew have 5 cases: e.g. 'an impersonation', 'some students gate-crashing at a tutor's tea-party'; the Gw have 14. This time there is more activity, but in 7 out of the 14 cases 'she' (as in Qu. 8*a*), is the completely passive heroine 'a fortune-teller told her she was to marry soon', 'one had too high an opinion of her', 'she noticed that somebody she did not like very much was fond of her'. Two Gw gave the rather puzzling answer 'suicide of somebody she knew'. Was this meant as a protest against a question which implied that in these grave times there were still people who thought there was some fun in life? Or was 'funny' taken in the sense of perplexing? This question became still more acute in the group of purely intellectual answers which are, with one exception, entirely supplied by the Gw. There are 13 answers, most of them of an outstanding sarcasm and bitterness, dealing with abstract ideas 'that some people are only interested in pleasure', 'that mankind is still struggling for peace', 'a newspaper report: at the U.N.O. conference in Paris, Germany was represented by Schumann and Beethoven'.

What went on in the Gw's mind when they gave those answers is a problem which this investigation cannot solve. One has to be content with the statement that the numbers of perceptual and of intellectual answers are inverse in the 2 groups (Ew 23:1, Gw 8:13) and that these figures and the quality of the responses throw into relief a fundamental difference between the two groups. It is a difference in inner experience. It appears that the outside world, people, objects and events are differently seen, interpreted and integrated. The contact with reality is more direct on the Ew side, stimulation from the outside through the senses, be it sight, hearing or touch, is readily received and directly experienced and recorded. The Gw mechanism is more complicated. Reality is first related to the self and subjectified before it is accepted and integrated. The contact is indirect. The subjectifying process stands between reality and experience. Hence the impression of greater aloofness and the tendency to generalizations and abstractions.

Question 10.

Tables 24–26 give the results.

The wish for husband, family and home is the leading Ew wish and is also strongly represented in the Gw group. 'Her own home' without mention of husband and family is cited by more Gw than Ew. This may perhaps be taken to reflect the appalling housing conditions at the time of the test. Material goods and security seem to be even more important to the Gw than home and husband, although the wish for money is surpassed by the desire for books and bookshelves. Otherwise the groups' wishes are very much alike; journeys, a secure future, a successful termination of the training and a good job. Fifteen Ew against 3 Gw express some desire for self-fulfilment 'satisfactory outlet in all directions'.

The number of items mentioned in connexion with the £1000 varies from 1–4 in the individual answers. If several items are mentioned this takes either the form of a

Table 24. *Qu.* 10. *She dreams she gets what she wants.* (*a*). *What does she get?*

English women	Absolute no. of answers
Material goods and security:	
Money (3), clothes, holiday, journey, a secure future, etc.	9
Domestic fulfilment:	
A husband (5), children, own home/house and family, etc.	18
Success:	
A degree (2), teacher certificate, better job, etc.	7
Self-fulfilment:	
Independence (3), happiness (3), a full life, congenial work, outlet in all directions, etc.	15
'More than is good for her', 'nothing like what she wanted'	2
Unclassifiable	2
	53

German women	Absolute no. of answers
Material goods and security:	
Money (5), a scientific book (5), journey abroad (4), book shelves/book cupboard (2), good living conditions, a beautiful future, a nice handbag, etc.	21
Domestic fulfilment:	
Home of her own (5), the ideal husband/husband/children, a child, twins, etc.	12
Success:	
Her exam. (4), good job (3), a prize (3)	10
Self-fulfilment:	
Congenial work (2), escape from the narrowness of her home	3
Unclassifiable	3
Vague:	
'Can fulfil her own and family's wishes'	1
Illegible	1
Blanks	2
	53

enumeration 'furniture, books, car, travels' or of a budget 'a part of it to her parents, some for clothes, most of it on education'. The enumeration is more frequent amongst the Gw, the budget amongst the Ew.

Sixteen Ew save at least part of the money and this is followed closely by gifts to parents or family, and by journeys. House, home and furniture are mentioned by 6 Ew against 24 Gw. This is the leading Gw response and undoubtedly corresponds to an acutely felt need in real life. Next comes 'journeys' (22 Gw). These two categories stand out from all the rest; 'books' are far behind with 9 and the 'family' with 8 scores. Part savings are

Table 25. *Qu.* 10(*b*). *She is given* £1000, *what does she do?*

	English women		German women	
Spends it on	Mentioned amongst other items	Mentioned alone or first amongst other items	Mentioned amongst other items	Mentioned alone or first amongst other items
Father	1	1	.	.
Mother	3	1	1	1
Parents and family	14	7	8	6
Others	11	8	6	1
House and furniture	6	5	24	17
Car	2	1	1	.
Clothes	4	2	5	4
Journeys	13	9	22	9
Books	3	1	9	7
Study	4	2	5	3
Saves all	5	5	3	3
Saves part	16	4	2	.

only mentioned by 2 Gw. The full amount is banked 'temporarily' by 3 Gw, and withou restrictions, by 5 Ew. Again one may assume that the difference is due to the economi conditions prevailing in the two countries at the time of the test.

Although disappointment on waking up is the most frequent response in both groups mixed feelings and other reactions are fairly evenly distributed in the Ew group while o the Gw side outright disappointment and resignation are so much to the fore that not muc margin is left for other reactions.

Question 11.

Tables 27–29 give the results.

Question (*a*) can be understood as referring to personal conditions or to conditions general. If the answer to it is a laconic 'yes' or 'no' there is no indication as to wh exactly is meant, but one might feel tempted to think that a feeling of satisfaction or di satisfaction finds expression. This, however, may be misleading. Common experience ten to show that many more people are dissatisfied than satisfied, in fact, one may conte that it is against human nature to be fully satisfied. Curt 'yes' answers, therefore, cann be taken at their face value.

Forty-two Ew answered with 'no' and only 7 gave 'yes' answers. On the Gw side on more the order is reversed, with 14 'no' and 24 'yes'. As could be expected from the 'ye figures the need for additional qualifying remarks was stronger amongst the Gw: 'yes, s always makes the best of it', 'yes, she has to be and she firmly believes in a better futur These answers sound more like resignation than satisfaction and reveal a conscious eff

Table 26. *Qu.* 10(*c*). *She awakes and finds she has been dreaming, what does she feel like?*

English women	Absolute no. of answers
Disappointment:	
Feels sorry, it is a pity, horribly disappointed, disturbed, frustrated, miserable, depressed, etc.	16
Resignation:	
Might have known, resigned to reality, too good to be true, nothing comes to her the easy way, etc.	10
Disappointment but:	
Hopes it may come true, does not regret it, feels inspired, soon laughs at it, etc.	9
Indifference:	
Does not really mind, made little impression, just getting on as usual, etc.	10
Amusement:	
Laughs, is amused, enjoyed it, sees funny side of it, etc.	7
Rather glad	1
	53

German women	Absolute no. of answers
Disappointment:	
Disappointed (16), what a pity, feels sorry, sad feeling, grief and depression, reality felt still more, etc.	25
Resignation:	
Knows that it will never come true, used to disappointments, better as it is, more happiness if one works for it, money is not all-important but man's will, everything beautiful in life is a dream only, etc.	13
Disappointment but:	
Hopes it will come true one day, hopes she will achieve something, etc.	3
Indifference:	
Not impressed, does not feel much, etc.	3
Amusement:	
Laughs, enjoyed it, etc.	5
Feeling of happiness	1
Relieved, glad	2
Vague	1
	53

Table 27. *Qu.* 11(*a*). *Is she satisfied with things as they are?*

English women	Absolute no. of answers
Yes	7
No	42
Moderately	4
	53
Additional remarks:	
General conditions:	
Things can always be improved, would like better conditions for the poor, would like more people happy, etc.	5
Personal conditions:	
Hoping to improve, always striving to do better, would not have any major changes, etc.	11
	16

German women	Absolute no. of answers
Yes	24
No	14
Moderately	15
	53
Additional remarks:	
General conditions:	
She alone cannot change things, she would change a lot, would like to alter them according to her own vision, would like to see a better world, etc.	6
Personal conditions:	
Makes the best of it, can adapt herself to anything, strives to achieve more, God is with her, etc.	18
	24

Table 28. *Qu.* 11 (*b*). *What does she aim at doing?*

English women		Absolute no. of answers
Egoistic aims:		
Work:		
Degree, making a success of life (3), getting on in job, improve her standard of life, etc.	16	
Domesticity:		
Having home of her own, settling down with a husband, etc.	6	
	—	22
Altruistic aims:		
Making others happy	4	
Usefulness to community at large:		
Improving social conditions, help in general reform, trying to help in some useful capacity, making country a better place, spreading economic knowledge, etc.	12	
	—	16
Egoistic and altruistic aims combined:		
Giving and getting best out of life, improving own life and helping those around her, being a perfect wife, becoming a good teacher/efficient in her work (3), etc.		9
Passivity:		
Hopes for the best, just accepts things, continuing working until lucky break, etc.		5
Unclassifiable		1
		53

German women		Absolute no. of answers
Egoistic aims:		
Work:		
Secure position/security (6), get on in her job (3), independent work (2), success in life, satisfying life, satisfying work, etc.	28	
Domesticity:		
Middle-class family life, farm of her own and happy family life, etc.	4	
Achieve happiness:		
Be always content, live a harmonious life, etc.	4	
	—	36
Altruistic aims:		
To help people		1
Egoistic and altruistic aims combined:		
Achieving much and giving pleasure to others, first improve herself then her environment, become a personality who is loved and respected, an intellectually rich and harmonious life for herself and the world around her, striving towards a community where there is peace, becoming efficient in her work, etc.		8
Vague:		
To be able to live a life as she visualizes it, put her resolutions into practice, etc.		7
Blank		1
		53

Table 29. *Qu.* 11 (*c*). *How does she set about it?*

English women		Absolute no. of answers	German women		Absolute no. of answers
By work:			By work:		
Working hard/studying (5), by persistence and industry, doing her utmost, improving her knowledge, making herself efficient, first obtains her teacher certificate, etc.		20	Works unceasingly (11), works hard to reach her goal (3), puts in all her strength, does not spare any effort, trains for a profession, works harder and harder, etc.		29
By own moral improvement:			By own moral improvement:		
Disciplining herself		1	Studies to improve (5), fights her own weakness		6
By social attitude:			By social attitude:		
By trying to understand people, by not letting her surroundings hamper her		2	Peaceful herself and does not gossip, loves and respects her fellows, endeavours always to see the best and to understand people, her highest commandment is love for her neighbour, etc.		7
By social action:			By social action:		
Definite programme: works in conjunction with persons and groups of similar ideas, contacts local organizations and interests herself in the members, etc.	19		Definite programme: sometimes takes a child into her home and helps wherever she can, perhaps she writes books to educate people for peace	2	
Vague: always does her best in everything she attempts (2), taking the plunge and trying hard, etc.	6		Vague: asks her fellows to set an example and does it herself, being a practising Christian, being cheerful at work and a good comrade	3	
	—	25		—	5
Passivity:			Passivity:		
Letting events take their course, etc.		3	Works and waits for right companion, does her duty, etc.		5
Unclassifiable		1	Blank		1
Blank		1			—
		53			53

ut up with an unsatisfactory state of affairs. Real contentment is remote. On both s the additional remarks mainly refer to personal conditions.

he aims were classified as egoistic and altruistic. Under egoistic came all those which e exclusively concerned with her own life, success and well-being. More than half as ny Gw as Ew come into that category (36:22). Success in work or in life in general, with urity much emphasized on the Gw side, takes precedence over the aim to have her own ne and family. As the way to success is usually paved with hard work there is not much hoose for those travelling along it, and there is hardly any difference between the two ups on that point, except perhaps that the Gw are more monotonous, 'works unceasingly', rks harder and harder', and that the Ew go more into detail 'goes to evening classes does extra studies at an art school'. The candidates for matrimony, however, tackle problem in a very different way, the Gw 'working dutifully while she waits for the t companion', the Ew 'endeavouring to find somebody with the same interests and look on life'.

hose pursuing altruistic aims are either concerned with bringing happiness to small ups of people, e.g., 'making others happy', or else have the whole community in mind. y 1 Gw states that she aims at helping people, whereas 16 Ew have altruistic aims, 12 hem mentioning expressly the community at large. A third group which is represented qual strength on both sides (9), mentions altruistic and egoistic aims together: 'improving own life and helping those around her'.

hen it comes to saying how the purely altruistic or the mixed aim is to be achieved Ew programme in 19 cases is very definite, essentially active and entailing contact h people. Some Ew went into great detail 'by being as well informed as possible on rent events, an active member of the Labour party and Church activities, and an interest he individual'. In comparison the 2 Gw answers with some semblance of a concrete gramme sound singularly shy and remote. The Gw who wanted to help 'sometimes takes ild into her home and helps where she can', the Gw who wanted a peaceful world says rhaps she writes books to educate people for peace'. Seven other Gw see the way rather heir social attitude, e.g., 'peaceful herself and does not gossip' than in taking active steps. here is undoubtedly a marked difference between the two groups. The most striking ure is the strong community-consciouness of the Ew which has no counterpart in the group. It is true that in English training colleges the emphasis is laid on the community arge, that all group activities such as dramatic clubs, folk dancing, etc., are encouraged interest in politics and current affairs fostered. As before admission to the college, cial attention is given to the candidate's previous social activities, if prefect at school, tain of sports team, etc., a selective principle may have been at work in the Ew group. may further be that selection worked in the opposite direction in Germany if, as it is ly although no data are available for the moment, the Gw were selected on the strength heir previous scholarly achievements. If this were so, presence or absence of community sciousness could be traced back to a fundamental difference in the educational aims he two countries.

stion 12.

ables 30 and 31 show the results.

he question directly addressed to the subject is an interruption of the process of ntification. The subject is reminded of the test situation and she is asked to pass

Table 30. *Qu.* 12 (*a*). *What do you like about the person you have described?*

English women		Absolute no. of answers
Qualities needing other people for their exercise	*c.* 42	
Qualities not necessarily needing other people for their exercise	*c.* 34	
Keenness on sport	3	
Total number of qualities mentioned	79	
All qualities mentioned need other people for their exercise and/or appreciation: e.g. friendly and open		3
All qualities mentioned do not necessarily need other people for their exercise and/or appreciation: e.g. 'her neat mind, ideals and unselfishness—she is optimistic and not bitter'		12
Qualities which need people and qualities which do not need people mentioned together: e.g. 'easy to get on with but does not tolerate dishonesty'		4
'Other people' expressly mentioned or clearly implied: e.g. 'her vital interest in others', 'she likes to listen to both sides'		17
Sport: keen on sport		3
Connected with the picture: 'she looks a healthy type'		1
'Nearly everything'		1
'Much in common', 'all my own desires and troubles', 'became real', etc.		5
Disliked: very little, nothing, 'don't like her altogether', etc.		7
		53

German women		Absolute no. of answers
Qualities needing other people for their exercise	*c.* 23	
Qualities not necessarily needing other people for their exercise	*c.* 47	
Total number of qualities mentioned	70	
All qualities mentioned need other people for their exercise and/or appreciation: e.g. her simplicity and grace, well-meaning		6
All qualities mentioned do not necessarily need other people for their exercise and/or appreciation: e.g. knows what she wants, her inwardness and striving for true humanity		22
Qualities which need people and qualities which do not need people mentioned together: e.g. her cultured thoughtful ways, her good taste		8
'Other people' expressly mentioned or clearly implied: e.g. always there for other people, 'that she is a Christian in deed'		2
Connected with the picture: simple appearance, posture, simple hairstyle, her seriousness on the picture, 'her simple appearance implies inwardness', etc.		10
'Ideal figure', 'she is my ideal', 'everything', etc.		5
		53

Table 31. *Qu.* 12(*b*). *What do you dislike about her?*

English women	Absolute no. of answers
Main characteristics mentioned:	
Not active enough:	
Lack of ambition, sitting on the fence, too bound up in herself, plays no full part as member of society, lives too much in the future, etc.	12
Loss of control:	
Her bad temper when roused, impatient with children, impulsive, often bad tempered, unable to control herself, loses her temper, etc.	9
Selfishness:	
Selfish, always putting herself first, selfish care of herself, often thoughtless of others, etc.	6
Stubbornness (4), too self-satisfied/complacent/condescending (4), dullness/lack of spontaneity/no sense of humour/too serious/annoying to live with (6), worrying too much (2), laziness (2), misc. (6)	24
'Everything'	1
'Nothing'	1
	53

German women	Absolute no. of answers
Main characteristics mentioned:	
Being unwomanly:	
Too independent makes her appear unwomanly, too ambitious in her work at the expense of being a woman, no good as a housewife, too little influenced by her feelings although she feels strongly as a woman, etc.	10
Too much emphasis on work:	
No balance in physical activities, over mental work forgets reality, knows no end where work is concerned, should mix more, etc.	9
'An ideal figure is perfect', 'nothing', 'only a few details', etc.	15
Connected with the picture:	
'Cannot see her face', 'cannot see what she is doing', 'her forced posture', etc.	6
Too materialistic, superficial, cold	5
Too intent on right, gets too excited; too passionate	2
Too exact (1), too obstinate (1), selfish (1)	3
Blanks	3
	53

judgement on her own creation. The observable reactions were scrutiny of the picture an reading through the script. As a result 10 Gw described the picture mainly stressing th 'simplicity' of appearance, costume, hair style. Some began to project anew: 'her simp appearance implies inwardness'. The only parallel Ew answer states 'she looks a health type'.

Identification can occur on three levels:

(*a*) as one is; one's good and bad qualities are projected directly (there can be a tren toward projecting more good or more bad qualities);
(*b*) as one would like to be; only good qualities are projected; it is an idealizing proce less direct than (*a*);
(*c*) as one would not like to be; only bad qualities are projected; it is the reverse proce of idealizing.

In view of the identification, one might expect that at some point in the story, in dire as well as in idealizing projection, the girl would have been vested with the qualities t subject valued and that, therefore, there would be some connexion between the characte istics mentioned in answer to the present question and to Qu. 4(*a*). On the whole, th proved true and again the Gw laid greater stress on qualities which do not need oth people for their exercise and appreciation, while the social aspect is more to the fore wi the Ew.

The stronger the trend towards a negative projection the more difficult it will be for t subject to find points which are liked. Seven Ew say they liked the girl very little disliked her. Five Ew became conscious of direct projection, 'much in common', 'all r own desires and troubles'. The nearest approach to an idealizing identification on the l side is the one 'nearly everything'. One may say that in the main the Ew identification direct with a tendency towards a negative projection. Five Gw stated 'she is my ide and the full extent of their positive identification shows most clearly when they have say what they disliked. A subject who has consistently idealized will find it impossible pick holes in her creation. Hence the 15 Gw answers 'an ideal figure is perfect' or 'nothin to which presumably the 3 blanks can be added. A strongly positive but not complete idealizing identification will result in depreciating qualities in the girl which are in real highly valued and this seems to be the case of the 9 Gw who stress her overemphasis work 'she knows no end where work is concerned'. It is likely that they are really ratl proud of this capacity for work. That career and womanhood are experienced as a polar and that there are doubts whether the way chosen is the right one comes to light in 10 Gw answers mentioning womanly and unwomanly traits: e.g. 'too independent, ma her appear unwomanly'. Six Gw answers are concerned with the picture itself. It see that there may hardly be 10 Gw records which mention qualities which are really dislik

Their direct or negatively loaded identification made it easy for the Ew to state w they disliked and more than 30 of them mention some unpleasant traits, loss of cont selfishness, stubborness, dullness, etc. The most interesting group of Ew answers is forn by the 12 Ew who complain that 'she is not active enough', 'lacking in ambition' 'plays no full part as a member of society'. After the display of all-round activity may seem rather surprising and one may infer that the goal she has set herself is recogni as the right one but that there are doubts as to her ability to reach it. This group is a thetical to the Gw who struggle with the problem of independence versus womanh

d it is clear that the Ew group and the Gw group hold different views on the place of the man in the life of the community.

Attitude test summary and conclusions

The great number of differences found tends to obscure whatever they may have in mmon.[1] A survey of the main differences is given in Table 32. It states question by estion the leading answers of both groups, together with their numerical relationship d statistical significance, and where the leading answer did not coincide with the most rked difference, that difference is also given. From the first column the blanks can be n as they occurred in each group. The Gw average per question is 2, the Ew average is ($p = 0{\cdot}001$). The blanks in general denote rigidity, inflexibility and emotional blocking ich may also imply some opposition to the test situation. Table 32 is a purely quantita- e comparison and shows that in spite of opposite trends between the groups there is also air amount of agreement without which any classification would have been impossible. ry few classes of answers indeed have no counter-part in the other group. This, of course, es not take into account the qualitative differences which may be, and in fact more often an not, were found in responses belonging to the same class in the two groups. The mulative effect of the qualitative differences may be best conveyed in composite sions of the whole story. These are given on p. 112.

To summarize, it appears that the Gw identified themselves from the outset with the l of the story. They invested her mainly with qualities which seemed desirable to them d the personality picture they drew can be taken as representing the Gw group's ideal near-ideal. Questions which implied the presence in the girl of qualities which were sidered undesirable (e.g. fear, aberration from the truth) met with some opposition. e test was taken very seriously. Intellectual pursuits are highly valued and a teaching eer, apart from reasons of security, may have been chosen in the hope that it may ord opportunities for them. A central place is assigned to work. Genuine interest in dy and economic difficulties which turned the successful termination of the training rse into a vital issue, may partly account for the tension and single-mindedness in the riving towards the goal' as the Gw frequently express it, but beyond this a fundamental itude seems to be involved. Work is equated with duty and as such is given priority er the claims of the body (Qu. 8*b*) and over human relationships (Qu. 5, Qu. 7). Friends chosen for their intellectual superiority and their character, and weight is given to nness and depth of their inner life as opposed to shallowness and superficiality (Qu. 4). e-occupation with the work when it is finished (Qu. 1) and with past incidents (Qu. 5*b*) ows a tendency towards mental perseveration. A point of view once taken up and thought be right is not easily relinquished (Qu. 5*b*). It seems that not only the test situation was ken seriously but life in general and that the lighter side of it is not readily appreciated u. 9). Whether this is entirely due to Germany's post-war conditions and is transitory is a mental attitude more or less independent of extraneous circumstances cannot be cided on the strength of this test alone. The strong wish for an independent and intel- tual career seems by many of the group to be experienced as incompatible with an ideal womanhood (Qu. 12*b*).

[1] It is true that some of the differences noted are only suggested by responses of a very small number of ividuals in each group of 53 subjects. However, if one considers that the 53 subjects on each side were tested wo or more groups and that the differences observed tended to be present in each of the subgroups there me reason to believe that with larger groups these differences might be significant.

The Ew took the test more in the spirit of a game; they were detached and slow identify. As the test proceeded they could not avoid drawing on their personal experien with consequent identification. The girl of their creation is true to life but it is not alwa clear whether the traits which were assigned to her are accepted or rejected or even mea at all seriously. The impression is that work is not all-important, that interest in others perhaps also a useful method of achieving proficiency in the chosen profession and derivi satisfaction from it (Qu. 12*a*), and that activities should be spread over a wide field, no being pursued exclusively or to the point of exhaustion (Qu. 8*c*). It may be that a sense balance leads them not to attach too much weight to details: they will readily confess a fear of spiders (Qu. 8*a*) or to having missed a train (Qu. 7*a*). It is a quality which besid ease in social contact they prize in themselves and others, and to which they sometim refer as a sense of humour (Qu. 4*a*). On the other hand, they dislike or laugh at fuss ov trifles (Qu. 4*c*) and are quick to see the incongruous (Qu. 9). There is readiness to come terms or to yield to another's point of view (Qu. 5*b*). This may be the result of the abili to identify with the opponent and appears to be the application in a life situation of t shifting identification noted in the test (Qu. 3*c*). The realization of being a member society finds clear expression and so do the doubts as to whether the obligations entail will be fully met.

So far the findings agree with empirically established ideas on German and Engli characteristics. From a scientific point of view, the agreement of results with experien is, of course, of paramount importance for the validation of test and method. If kno facts show up clearly in a test one feels entitled to assume that other points revealed by are worthy of consideration.

In the present experiment Qu. 9, the recording of the funny incident, proved to be cruci There was a difference in choice of incidents, perception and formulation, and it w realized that underlying it there might be a difference in inner experience. It was stat then (p. 86) that the contact with the outside world tended to be more direct on the E side, that stimulation through the senses was more readily received and experienced; th the Gw, on the other hand, tended first to relate outer experience to the self and to su jectify it before it was integrated. If the reactions throughout the test are viewed w this in mind they assume a new meaning. To Qu. 1*a* the Ew reacted with the interest the moment, 'reading', 'writing'. It can be directly inferred from the picture and is t nearest approach to an objective statement of a fact. The Gw reacted with 'acader pursuits'. To give this answer a subjective point of view had to be taken up first. In Qu. the Ew criticized directly the work in hand, the Gw conceptualized the work and sta what it meant to them. The Ew remarks 'I must have some sunshine' or 'I will stre my legs' in the formulation take account of the physical phenomena 'sunshine' and 'le and in content represent a direct reaction leading to immediate action. The Gw 'I sho like to go for a walk' is a subjective statement of feelings, and implies thoughts about advantage of walking without indication of action.

There is hardly a counterpart on the Gw side for the Ew body-consciousness, e.g. 'bac sore' when the work is finished, 'she gets pink' when she is angry. Nor is there a counterp to the Ew awareness of environmental stimuli: their 38 items of physical fears and answers 'noise' and 'noise and people' to questions about what annoys her and what does when tired. Work is liked and disliked for extrinsic reasons by most of the Ew, and intrinsic reasons by many Gw. Man is appreciated in his social environment by the Ew, an

Table 32. *Summary of the main differences*

Question	Blanks Ew	Blanks Gw	Leading Ew answer	And/or greatest difference	No. Ew	No. Gw	t	p	Leading Gw answer	And/or greatest difference	No. Gw	No. Ew	t	p
1 (*a*)	0	0	Momentary interest is writing, reading	—	62%	19%	5	<0·001	General interests academic	—	65%	33%	3·5	<0·001
(*b*)	0	3	Attitude towards work done active critical	—	26	6	4·7	<0·001	Attitude towards work done passive reflective	—	16	3	3·5	<0·001
2 (*a*)	0	0	Real work is office work	—	27	11	3·2	0·001	Real work is study	—	29	16	2·7	<0·01
(*b*)	3	4	Work liked for extrinsic reasons	—	32	13	4	<0·001	Work liked for intrinsic reasons	—	36	14	4·7	<0·001
(*c*)	4	5	Disliked for extrinsic reasons	—	39	23	3·3	0·001	Disliked for extrinsic reasons	—	23	39	—	—
			—	—	—	—	—	—	—	Intrinsic reasons	19	8	2·5	0·01
3 (*a*)	0	1	Work seen by employer	—	33	12	5	<0·001	Work seen by tutor	—	17	12	—	Not s.
(*b*)	2	3	Comment refers to work	—	31	25	1·2	Not s.	Comment refers to work	—	25	31	1·2	Not s.
			—	Comment unfavourable	7	0	2·9	<0·01	—	—				
(*c*)	0	5	Thinking same as saying	—	22	39	3·5	<0·001	Thinking same as saying	—	39	22	3·5	<0·001
			—	Thinking worse	12	2	3·2	0·001	—	—	—	—	—	—
(*d*)	2	6	Uncertain about work done	—	24	28	—	—	Uncertain about work done	—	28	24	—	—
			—	Dissatisfied	12	6	1·6	Not s.	—	Fully satisfied	16	10	1·3	Not s.
4 (*a*)	0	0	People liked for social traits	—	27	5	4·8	<0·001	People liked for mental traits	—	29	11	3·8	<0·001
(*b*)	1	0	Company of more than one preferred	—	34	41	1·6	Not s.	Company of more than one preferred	—	41	34	1·6	Not s.
			—	Men and mixed	14	5	2·3	0·02	—	One person	10	5	1·5	Not s.
(*c*)	0	1	People disliked for social traits	—	26	13	2·8	<0·01	People disliked for mental traits	—	29	14	3·2	0·001
			—	—	—	—	—	—	—	'Superficial'	11	1	3·4	<0·001

For methods see Bradford Hill (1).

Table 32 (*cont.*)

Question	Blanks Ew	Blanks Gw	Leading Ew answer	And/or greatest difference	No. Ew	No. Gw	*t*	*p*	Leading Gw answer	And/or greatest difference	No. Gw	No. Ew	*t*	*p*
5 (*a*)	2	3	Argument about herself	—	28	32	—	—	Argument about herself	—	32	28	—	—
(*b*)	1	5	—	Agreement both seeing other's view	8	2	1·9	0·05	—	Winning by disregarding other's view	12	5	1·8	<0·1
6 (*a*)	0	1	People's qualities are annoying	—	61%	49%	3·2	0·001	People's qualities are annoying	—	49%	61%	3·2	0·001
			—	Environmental interference	14%	5%	1·6	Not s.	—	Personal difficulties	20%	4%	2·6	<0·01
(*b*)	0	1	Anger released	—	29	17	4·5	<0·001	Withdraws	—	19	1	7·5	<0·001
7 (*a*)	0	0	Appointment missed through negligence	—	22	4	4·5	<0·001	Appointment missed through work	—	31	8	5·3	<0·001
			—	—	—	—	—	—	—	Absorbed in work	11	1	3·2	0·001
(*b*)	0	1	States facts and apologizes	—	10	10	—	—	States facts without apologies	—	17	6	2·6	<0·01
8 (*a*)	0	3	Physical fears	—	58%	11%	5·9	<0·001	Mental fears	—	43%	29%	1·6	Not s.
			—	—	—	—	—	—	—	Fear of others' actions	12%	4%	1·6	Not s.
			—	—	—	—	—	—	—	'She is not frightened'	21%	0	3·7	<0·001
(*b*)	0	0	When tired she has depressed thoughts	—	28	24	—	—	When tired she has depressed thoughts	—	24	28	—	—
(*c*)	0	2	Stops working	—	36	12	5·3	<0·001	Continues working	—	18	6	2·9	<0·01
			—	Relaxes	14	2	3·4	<0·001	—	Goes on worrying	11	4	2·1	<0·05
9	4	11	Incongruous sight of people is funny	—	17	7	2·4	<0·02	Funny things appreciated intellectually	—	27	6	3·9	<0·001

10 (*a*)	0	2	In dream wants and gets domestic or self-fulfilment	—	33	15	3·7	<0·001	In dream wants and gets material goods and security	—	21	9	2·7	<0·01
(*b*)	0	0	With £1000 helps family, saves rest	—	30	10	3·7	<0·001	With £1000 gets house, furniture, travels	—	46	19	6·4	<0·001
(*c*)	0	0	Awakes, is disappointed	—	16	25	1·8	<0·1	Awakes, is disappointed	—	25	16	1·8	<0·1
			—	Hopes it will come true	9	3	1·9	<0·05	—	—	—	—	—	—
11 (*a*)	0	0	Not satisfied with things as they are	—	42	14	6·5	<0·001	Satisfied with things as they are	—	24	7	3·7	<0·001
(*b*)	0	1	Egoistic aims	—	22	36	2·8	<0·01	Egoistic aims	—	36	22	2·8	<0·01
			—	Usefulness to community	12	0	3·7	<0·001	—	Success in work and life	28	16	2·5	<0·01
(*c*)	1	1	Aim will be achieved through social action	—	25	5	4·7	<0·001	Aim will be achieved by work	—	29	20	1·8	<0·1
			—	Definite social programme	19	2	3·2	0·001	—	—	—	—	—	—
12 (*a*)	0	0	Liked for her interest in others	—	17	2	4·6	<0·001	Liked for her character	—	22	13	1·8	<0·1
			—	Not liked	7	0	2·8	<0·01	—	'My ideal'	5	0	2·4	<0·02
(*b*)	0	2	Disliked for not being active enough	—	12	0	3·7	<0·001	'Ideal figure is perfect'	—	15	1	4·1	<0·001
			—	—	—	—	—	—	—	Too independent and unwomanly	10	0	3·5	<0·001
	20	61												

is seen as a thinking and ethical being by the Gw. These differing trends can be shown questio by question. They find their logical conclusion in the aims of the groups, the Ew seeing against a background of social activities and the Gw in single-mindedness and their ow attitude. The Gw might call the Ew superficial, whereas the Ew might smile at the Gw emphasis on depth and inwardness. Understanding between individual members of the grou may be easily reached, but between the outlook most readily sanctioned by the two grou as a whole there is a gulf. Reality seems to be perceived in a different way. Contact with t phenomenal world can only be achieved through sense perception, it can be extensive, i distributed over a wide surface area, or intensive, that is, penetrating deeply into a restrict surface area. In the sense of the method of perceiving environmental stimulation the E have shown themselves to be more 'superficial' and the Gw more 'deep'.

IV. The Group Rorschach test, free association method

(*a*) *Method*

Each subject was provided with a booklet of 10 double pages folded in such a way th a flap covered the left-hand page on which was a diagram of each of the ten Rorschach car in turn and the scoring categories 'form, movement, colour, texture'. The instruction the front page said 'turn page for first answer. Always write on the right-hand page a do not turn the flap on the left-hand side until instructed to do so'. Five 5 cm. Kodachro roll film slides of the Rorschach cards were projected on a screen. Each of the slides w shown for 2 minutes in the darkened room. The light of the lantern proved sufficient f the subjects to write down their spontaneous answers. A second showing enabled t subjects to elaborate their answers on the opposite page. For the preliminary instructio and the exact procedure for the two parts of the test the reader is referred to Harrower Steiner's (2) book *Large Scale Rorschach Techniques*. The whole test took 1 hour 20 minut

It has to be borne in mind that in the resulting record the right-hand side of the book corresponds to the spontaneous performance in an individual Rorschach test, the le hand side of the booklet to the elaborations usually elicited in the inquiry.

Each record booklet was scored individually. The scoring of the Rorschach Resear Exchange was adhered to.

(*b*) *Results* (*Table* 33)

Number of responses.

The 23 Ew gave 503 responses, the 23 Gw 389. The arithmetical mean is 21·9 for the (S.D. 0·94), and 16·9 for the Gw (S.D. 1·1). The difference is highly significant ($p = 0{\cdot}00$ In general the number of responses can be taken as a fairly objective criterion. So complications, however, have to be mentioned. In a number of individual respon synthesis had been achieved by combining different percepts into a meaningful wh and these responses had to be divided up in order to do full justice to their complex and give full weight to the determinants. Some subjects also differed in the way in wh they gave their responses. The difference was most marked in card X. In the first part the test some subjects would enter spontaneous responses (right-hand side of the book such as 'different beetles', 'gathering of animals', 'fairy garden', and in the second p of the test they might or might not outline 2–4 beetles, animals or flowers on the diagr at the left-hand side of the booklet. The spontaneous answers of others would be 'an ins ballet with spiders, moths, green caterpillars, black beetles, all dancing round rose pilla

1	19	.	14 : 5	.	14 : 3	3 : 1½	42	26	1+1	0+1	1	0+1	1	5	26	*M*	52	0+1
2	15	.	10 : 5	0+1	10 : 1	1 : 4	40	.	0+1	.	1+1	3	0+1	4	26	*M* (*H*)	33	1
3	20	.	9 : 11	.	9 : 1	1 : 4½	50	.	0+1	.	1+1	1	1	7	35	*FM*	60	1
4	19	.	11 : 8	.	11 : 0	0 : 3½	42	16	2	.	.	2	1	5	26	*FM* (*A*)	47	.
5	19	.	11 : 8	0+1	11 : 3	3 : 1½	32	10	1	1	1	3	.	5	26	*M*	36	.
6	27	.	13 : 13	.	13 : 6	6 : 3½	37	18	3+2	0+1	.	0+1	2+3	4	15	*M* (*H*)	33	.
7	15	.	9 : 6	.	9 : 2	2 : 3½	40	20	1	.	.	.	1+2	4	27	*M*	40	.
8	22	.	10 : 10	1	10 : 1	1 : 3½	36	31	0+1	.	0+2	2+0	2+1	4	18	*M*	40	2
9	25	.	11 : 13	.	11 : 3	3 : 7½	48	32	2+1	.	0+4	.	1	4	16	*M*	32	.
10	18	.	5 : 12	1	5 : 2	2 : 1½	50	44	2	1	0+1	.	0+1	6	33	*M*	56	.
11	24	.	15 : 9	.	15 : 3	3 : ½	37	20	4	.	.	1	0+2	7	29	*M*, *FM*	67	.
12	21	.	5 : 13	.	5 : 0	0 : 1	43	50	.	.	.	1	.	6	29	*FM* (*H*)	67	.
13	24	.	13 : 11	.	13 : 2	2 : 2	37	25	2	.	1	2	1	6	25	*Fm*, *Asymb.*	42	.
14	21	.	15 : 6	.	15 : 1	1 : 5	38	19	2+1	1	0+1	1	1+1	4	19	(*M*), *H*	25	3
15	18	.	12 : 6	.	12 : 2	2 : 4	39	11	2+3	.	0+1	.	2+4	5	28	*M*	39	1
16	34	.	25 : 8	.	25 : 6	6 : 6	38	15	2+1	.	0+8	1	3+6	5	15	*F*, *Hsymb.*	35	1
17	15	.	12 : 3	.	12 : 1	1 : 2½	26	33	3	1	.	.	0+1	2	13	*FM* (*A*)	33	.
18	23	.	8 : 15	0+2	8 : 0	0 : ½	26	78	.	.	1	.	0+1	4	17	*F* (*H*)	52	.
19	28	.	4 : 16	2+2	4 : 1	1 : 4	35	50	3	0+1	.	0+1	.	4	14	(*M*), (*H*)	57	1
20	24	.	17 : 6	1	17 : 5	5 : 5	33	8	3+4	.	0+1	1	0+1	5	20	*M* (*H*)	33	1
21	23	.	7 : 13	.	7 : 2	2 : 6½	43	30	1+1	.	0+1	0+1	2+4	6	26	*M*	39	2
22	26	.	18 : 8	0+1	18 : 3	3 : 6½	42	19	2	1+1	0+1	.	.	6	27	*M*	53	1
23	23	.	7 : 12	.	7 : 3	3 : 4	30	39	1	.	.	1	.	5	21	*M*	52	.
	503																	

German women

1	16	.	7 : 9	.	7 : 5	5 : ½	38	25	1+2	.	.	.	.	3	19	*M*	31	.
2	10	IX, X	7 : 3	.	7 : 2	2 : ½	10	40	1	.	.	1	.	4	40	*M*	33	.
3	12	IX	6 : 6	.	6 : 3	3 : 1	25	42	1	.	.	1	.	4	33	*M*	33	.
4	10	IX	9 : 1	.	9 : 1	1 : 1	33	20	1	.	.	.	0+1	5	50	*M*	40	.
5	17	.	10 : 6	1	10 : 0	0 : 0	23	51	2	.	1	1	0+1	4	23	*FM*	35	.
6	19	.	8 : 11	.	8 : 2	2 : 1½	47	21	.	1+1	1	2	1+1	2	11	*M*	42	.
7	11	IX	7 : 4	.	7 : 3	3 : 1	27	18	1	.	1	1	.	3	27	*M*	18	.
8	25	.	7 : 16	2	7 : 3	3 : 1	45	36	.	1	0+2	.	2+1	4	16	*M*	52	1
9	10	.	7 : 3	.	7 : 2	2 : 0	30	20	.	.	2	.	1+1	3	30	*M*	40	.
10	20	.	11 : 8	.	11 : 3	3 : 2½	45	20	.	1	.	3	1+5	4	20	*M*	60	.
11	13	.	8 : 5	.	8 : 3	3 : 2	38	15	0+2	1	1	.	.	3	23	*M*	38	.
12	21	.	10 : 11	.	10 : 0	0 : 4½	38	14	1	1+1	.	.	0+2	6	28	*FM* (*A*)	52	.
13	16	.	6 : 7	1	6 : 3	3 : 2½	37	18	1	.	0+1	2	1+1	3	19	*M*	38	1
14	23	.	5 : 16	2	5 : 3	3 : 2½	39	36	2	.	.	2	.	5	21	*M*	43	.
15	29	.	8 : 18	3	8 : 2	2 : 1	55	68	3	.	1	1	.	5	17	*M*	44	.
16	12	.	8 : 4	.	8 : 3	3 : 1½	33	17	.	.	1	1	.	5	42	*M*	42	.
17	22	.	8 : 14	.	8 : 4	4 : 1	50	32	1	.	.	.	3	5	23	*M*	28	.
18	14	.	6 : 7	1	6 : 2	2 : ½	43	21	.	.	0+1	0+1	3	4	29	*M*	50	.
19	19	.	7 : 12	0+1	7 : 4	4 : 2	47	31	1	.	1	.	1+3	6	31	*M*	42	.
20	14	.	8 : 6	.	8 : 4	4 : 2	36	7	.	0+1	3	.	1	3	21	*M*	43	1
21	15	IX	4 : 11	.	4 : 0	0 : 1	33	40	1	.	1	2	0+1	5	33	*F*, (*H*)	47	.
22	19	.	6 : 13	.	6 : 2	2 : 2½	42	32	2	.	0+2	.	1+1	4	22	*M*	39	.
23	22	.	8 : 13	1	8 : 0	0 : 1½	45	36	2	.	2	4	0+2	5	23	*F*, *H*	50	.
	389																	

Both subjects achieved synthesis but the former did not make the effort to go into detail and define exactly what they had seen. Only under the pressure of the instructions t specify their response more explicitly did some of them locate their percepts on the diagram As a precise answer is better than a vague one and there is no evidence that a percep which is not clearly defined has been clearly seen the two types of answer cannot b accepted as equal. It was thought best to divide up and score fully the responses give spontaneously in the main performance and to disregard the secondary entries whic appeared only on the diagram. The generalized answer was more frequent amongst th Gw as can be seen from Table 34. There are 8 Gw with only one answer to card X com pared with 1 Ew. As this treatment of the responses to card X, necessary as it was upset the comparison in many points it was thought useful to show in brackets (or b dotted lines in fig. 1) what the Gw figures would be if the secondary entries to card X– there were 20—were included. Even the 20 responses cannot detract to any extent fro the significance of the difference between the total number of responses given. The G

Table 34. *Individual number of responses per card*

	No. of responses	1	2	3	4	5	6	Rej.
Card I:	Gw	13	6	4	.	.	.	.
	Ew	6	14	3	.	.	.	.
Card II:	Gw	13	9	1	.	.	.	.
	Ew	8	11	2	2	.	.	.
Card III:	Gw	10	18	3	2	.	.	.
	Ew	6	8	9	.	.	.	.
Card IV:	Gw	17	5	1	.	.	.	.
	Ew	5	13	3	2	.	.	.
Card V:	Gw	21	2	.	.	.	.	.
	Ew	9	11	3	.	.	.	.
Card VI:	Gw	11	11	1	.	.	.	.
	Ew	8	10	4	1	.	.	.
Card VII:	Gw	17	3	3	.	.	.	.
	Ew	12	5	5	1	.	.	.
Card VIII:	Gw	5	10	5	1	.	2	.
	Ew	2	7	11	3	.	.	.
Card IX:	Gw	5	7	6	.	.	.	5
	Ew	5	12	2	3	1	.	.
Card X:	Gw	8 (3)	3 (2)	5 (6)	1 (4)	4 (4)	1 (3)	1
	Ew	1	4	8	4	4	2	.

were less productive than the Ew. It has, however, to be clearly understood that a gre number of responses in a record does not necessarily imply that the record is of goo quality. The quantity may have been achieved to the detriment of synthesis or of clearne in perception. To decide whether the productivity is the healthy result of a fertile mind a sign of anxiety or else shows an obsessive drive, the individual record has to be considere in all its aspects. In fact, the Ew records with the highest number of responses are qual tatively not the best in the Ew group. It would, therefore, be unjustifiable at this poi to go beyond the mere statement that there is a significant difference in the number answers between the two groups. In order to draw conclusions this fact will have to b considered in conjunction with other relevant tendencies.

Table 34 shows the individual number of responses per card, Table 35 the group tota per card, and Fig. 1 provides a graphic representation. The Ew are almost level on th first 7 cards. The drop at card V is not very accentuated although it is card V which yiel the lowest number of answers, followed very closely by card VII. Card VIII, the fir highly coloured card, gives an increase in answers followed by a drop on the difficult ca

and an increase on card X owing to the structure of that card. The Gw slight decrease card II may be due to colour shock. The strong increase at card III shows susceptibility kinaesthetic stimulation. The shading of card IV seems to have had an upsetting effect, lging from the number of answers, which is even lower than for card II. Similarly to e Ew the lowest number of answers is given to card V. The curve for the coloured last ee cards has the same tendency as with the Ew but the differences in the number of

Table 35. *Number of responses: group totals per card*

rds	I	II	III	IV	V	VI	VII	VIII	IX	X	Group total
Gw	37	34	43	30	25	36	32	56	37	59 (79)	389
Ew	43	44	49	48	40	44	41	61	52	81	503
Ew	+6	+10	+6	+18	+15	+8	+9	+5	+15	+22	+114

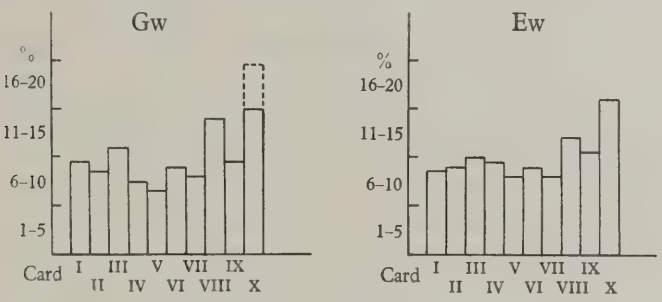

Fig. 1. Group total number of responses per card in %.

swers for the three cards are more pronounced. Contemplated beside the Gw graph the graph gives a more stable impression. The graphs afford some indication that, other ngs being equal, in the Gw group the handling of emotions may be less smooth than in e Ew group (colour shock on card II, great differences in the last 3 cards) and that neral anxiety may be stronger (shading shock on cards IV and V).

lation of whole answers to large detail answers, W:D.

Table 33 shows that $\Sigma(W+D)$ is 100% for 15 Gw and 13 Ew, i.e. almost the same number students did not go beyond whole or large detail responses. Although statistically not nificant there may be a stronger tendency towards $W > D$ answers amongst the Ew, t as the meaning of the W's depends on their quality not much can be deduced from purely quantitative assessment.

hite space answers; S.

No great differences were shown.

xture Fc, vista FK, diffusion K, relief Fk, inanimate movement m.

Comparing the Ew and Gw scores in Table 33, it appears that every one of the determinants was used to a slightly greater extent by the Ew. Moreover, while the Gw scores e mainly arrived at on the strength of the entries on the left-hand page of the record oklet, the Ew made more spontaneous use of these determinants.

The differences are slightest in *FK* and *Fk*, and greatest in *Fc* (texture) and *m* (inanimate vement). *FK* (vista), generally taken to denote insight, seems to be the rarest of all the terminants in both groups.

Pure form responses, F%.

A high *F*% is usually interpreted as a sign of rigidity of control; the less it is mitigate by the determinants *FK* (vista) and *Fc* (texture) the greater the rigidity. A low *F*% ma denote lack of control if the control is not expressed otherwise. It is a question of theoretic interest whether the group Rorschach test invites a greater number of spontaneous as we as second-thought elaborations than the individual test. In fact, the *F*% is rather low i both groups. There is no difference of any significance. Owing to the tendency of the E to use form together with other determinants rather more than the Gw, the mean *F*% slightly lower for the Ew. Their variability is greater. Two Ew have gone to such an extren in elaborating their responses that their *F*% equals zero.

Human movement M, sum colour sC, experience balance EB = M : sC (*Tables* 36, 37).

The term Experience Balance (*EB*) coined by Beck will be used in the following. As well known, it is a translation of Rorschach's (9) 'Erlebnistypus' and is numerically e pressed by the relation of the movement and colour answer scores: *M* : *sC*, *M* standing f the number of answers describing humans in movement, sum *C* being the sum of tl weighted scores of answers determined by the colour element. Sum *C* is taken to expre an individual's emotional reactivity to outside stimulation, whereas *M* is supposed to sho the spontaneous imaginative inner life and the reflective potentialities. The relatio between *M* and *sC* would show whether the personality is directed inward or outwar The *EB* is a fundamental Rorschach concept and accepted as valid by most authoritie The possible variations of the *EB* are: *M* > *sC*, introversial; *M* < *sC*, extraversial; *M* = *s* ambiequal; *M* and *sC*, both low (2 or less) constricted; *M* and *sC*, both high (3–4 or mor dilated.

The most striking differences of high significance appear in the use of these all importa determinants. The absolute number of *M* is almost identical in both groups (54 for G 51 for Ew) but taking the Gw lower total output into account their *M* responses for a more substantial part of the total. Fourteen per cent of all their answers were *M* again 10% with the Ew. On the other hand, the Ew showed much stronger reaction to colo and their upper quartile for *sC* lies at 5·06 against 2·43 for the Gw. These results are shov in Table 36. This trend, however, finds its clearest expression in the *EB* which is strong opposite as shown in Table 37, 17 Gw and 5 Ew, $p = > 0{\cdot}001$, being on the introversial si (*M* > *sC*), 4 Gw and 15 Ew, $p = > 0{\cdot}001$, being on the extraversial side (*M* < *sC*). Anoth interesting feature is that not a single Gw gave a dilated record (3 or more *M* and *sC* eac e.g. 4 : 5) against 6 Ew dilated records, and that 9 Gw had constricted records against 3 E Five of the 9 constricted Gw records and only 1 of the Ew's have a tendency towards (e.g. 1 : 0).

As far as the groups under consideration are concerned the Gw have shown an unequivoc introversial tendency, and the Ew a strong extraversial tendency.

In dilated records, according to Rorschach himself, introversive and extratensi elements appear. There is an abundance of emotional and imaginative life. As to constr tion there is general agreement that depression reduces the reactivity to movement a colour. Pedantry, self-consciousness in the test situation and critical control of thoug may have the same effect.

ercentage for the last three cards. (Percentage of the sum of the number of responses to cards VIII, IX, X from the total number of responses.)

A comparison of the figures is not likely to yield correct results owing to the previously entioned scoring difficulties with card X. The 20 responses which were only vaguely xpressed by the Gw might have changed the picture. As it stands there are hardly any umerical differences between the two groups. One may conjecture that the vague answers themselves are a sign of perceptual disturbance under the emotional impact of the lours and there is some confirmation for this in the rejections.

ejections.

There were no rejections amongst the Ew. Five Gw rejected card IX, one of them re-cted cards IX and X. The truth of the assumption that disturbance can be created in

Table 36

	Number of *M*								
								Quartiles	
	0	1	2	3	4	5	6	Median	Upper	Lower
een by number of:										
Gw	4	1	6	8	3	1	.	2·46	3·78	2·29
Ew	3	6	5	6	.	1	2	2·12	3·54	1·46

	sC																
																Quartiles	
	0	½	1	1½	2	2½	3	3½	4	4½	5	5½	6	6½	7	7½	Median	Upper	Lower
Given by number of:																			
Gw	2	3	7	3	3	4	.	.	.	1	.	.	.	.	.	.	1·47	2·43	1·15
Ew	.	2	1	3	1	1	.	4	4	1	2	.	1	2	.	1	3·94	5·06	1·96

Table 37. *Experience balance, EB*

				Three or more *M* and *sC* each			Two or less *M* and *sC* each		
	M>*sC*	*M*<*sC*	*M*=*sC*	→*M*	→*sC*	Sum	→*M*	→*sC*	Sum
Gw	17	4	2*	.	.	.	5	2	9‡
Ew	5	15	3†	1	3	6‡	1	2	4§

* Constricted. † Two dilated. ‡ Including two ambiequal. § Including one ambiequal.

notionally unstable people is demonstrated in an Ew answer to card X: 'Like confusion. o clear picture or straight way. Everywhere one looks there is something but there is no al form or reason'. This is an admirable verbalization of a state of perceptual disorganiza-on. The subject, however, recovered sufficiently to give a small detail answer which ved her from a total failure score.

ontent.[1]

(i) *Popular responses P.* These are the responses given most frequently by any number subjects to a particular blot area. In the scoring Klopfer & Kelley's(6) selection of 10 pular responses was used.

The differences are not great, although in percentage the Gw have given slightly more ving to their lower number of responses.

[1] The scope of this paper precludes a complete content analysis. This will be deferred until the results of all oups investigated are available.

(ii) *Percentage of animal responses A%, humans and human details H, Hd, objects Obj* No differences.

(iii) *Card III* .This card invites a movement answer. Nineteen Gw gave a straight forward human movement response against 12 Ew ($p = > 0{\cdot}01$). The rest of the Ew gave a variety of caricatures, marionettes, dressed-up animals, etc. The clearcut human move ment response is usually taken to be the most mature and best adjusted response.

(iv) *Card V*. It has to be remembered that the structure of this card does not lend itsel easily to a breaking up of the whole blot into detail answers, that the most popular answe is a 'bat' and that the shading is liable to arouse anxiety. The bat may be seen motionles (pure form, *F*) or in flight (animal movement, *FM*). All 23 Gw gave the bat answer bu only 3 spontaneously mentioned the movement, and this in spite of the fact that the Gw in general had shown themselves susceptible to movement. At first one might think tha they were perhaps more receptive to human movement (*M*) than to animal movemen (*FM*), the latter representing the more immature, instinctual drives. This, however, find no confirmation in the *FM*% of the Gw group which is the same as for the Ew. The possibl explanation for the failure to mention animal movement spontaneously in card V may therefore, be that it was due to the diffused anxiety which was aroused by the card. Thi tallies with the fact that card V showed a great decrease in responses as was pointed ou when the number of responses per card was discussed. It was there suggested that anxiet might be a restricting cause. This assumption is here supported by evidence on the wa in which the concept was seen. Incidentally, only two of the Gw added one more answe each to the 'bat' bringing thus the total number of responses for card V to 25.

Fourteen Ew gave bat or moth or butterfly, 5 saw it in flight. A variety of other answer brings the total number for the card to 40. The failure of 9 Ew to produce the popula response, which implies reluctance or inability to see the obvious, may also denote anxiet but of a more innocuous kind as a greater flexibility of mind is preserved.

(v) *Card X*. The finding of the strongly opposed tendencies in the *EB* of the two group is a matter of considerable interest, and in order to dispose of any possible doubt tha subjective scoring may have impaired the validity of the results it might be useful t illustrate by a few examples how the difference in experience between the two group found expression.

The examples are drawn from card X because it invites both colour and movemer responses (though mainly *FM*); in an individual performance it often needs a very caref inquiry to ascertain which of the two determinants was the dominant one.

Gw responses to card X:

'Two bears bowing to the king in the background, two scorpions hurrying to me the king.' (Note also the centripetal forces which tend to converge in the 'king'.)

'Meeting in the animal kingdom: spiders rush along with waving flags, mice, crab snakes, crocodiles,—all tend towards one symbol.' (Same centripetal tendency.)

'Animal fairy picture,—underground. Entry of Queen Snail.'

'Animals rushing madly to a goal.' (Centripetal.)

'Beetles' merry party with dance and music.' (Sense of movement so strong th music is imagined as well.)

'Walpurgisnacht.' (I.e. the night in which the witches ride on their broom stic It is characterized by a wild whirl. The association of 'night' with a highly colour

picture is particularly interesting and tends to show that the experience of movement must have been overwhelming.)

Ew responses to card X:

'Back cloth to fantastic ballet. Green crabs, brown creatures, green rabbit.'

'Chinese painting.'

'Under-water picture as can be seen in technicolour film.'

'Sea creatures as seen in glass case in aquarium. Colourful rocks usually in background. Golden pebbles on the floor.'

'Face in centre. "King of Hearts" in purple robes.'

'Native dance on pottery. Two witch doctors in red tunics. Lesser being in blue dancing wildly. Children in various colours dancing.' (Colour and movement were both strongly experienced.)

More examples on both sides could be given. It can be readily seen that under the ıpact of the Rorschach card the two groups differed widely in subjective experience and at no artificial technique was needed to discriminate between the two.

(c) *Summary of the main differences found between English and German women*

(1) The total number of responses to the 10 Rorschach cards is significantly lower for e Gw than for the Ew ($p = 0{\cdot}001$).

(2) The Gw in all probability had colour shock on card II, and their shading shock on rds IV and V is more pronounced than with the Ew. The increase and decrease in the ımber of answers per card roughly follows the same curve for both groups, but the Gw ndencies are more strongly expressed and their curve, therefore, gives a less stable ıpression.

(3) Both groups mainly gave whole (*W*) and large detail (*D*) responses. The Ew seem to 'eremphasize the *W* to the detriment of *D* more strongly than the Gw. (This difference statistically merely suggestive.)

(4) The use of the determinants other than movement (*M* and *FM*) and colour found ore spontaneous expression amongst the Ew.

(5) No rejections occurred amongst the Ew. Five Gw rejected cards. Card IX was jected five times.

(6) The Experience Balance (*M*:*sC*) in the two groups is opposite. Compared with Ew, ore than three times as many Gw gave responses determined by movement rather than colour ($p = > 0{\cdot}001$); compared with Gw, almost four times as many Ew gave more sponses determined by colour than by movement ($p = > 0{\cdot}001$); yet the absolute number movement responses is almost alike for both groups. Six Ew and no Gw gave dilated cords, whereas the number of constricted records is higher amongst the Gw.

(7) A greater number of clear-cut human movement responses to card III was given by e Gw than by the Ew ($p = > 0{\cdot}01$).

(8) The Gw decreased in the number of responses to card V more strongly than the Ew ıd the content of their responses was more rigid. A greater number of Ew failed to give e popular 'bat' response to that card.

(d) *Conclusions from the Rorschach test*

While sharing the mistrust of most Rorschach workers of the interpretation of isolated atures, the writer believes that group tendencies if clearly manifested must have a meaning

and that an attempt at elucidation is valuable (cf. Marguerite Hertz(3)): '...Isolatin patterns may serve to identify trends for the group, and their general meaning may be significance when applied to individuals in these groups.')

The two main differences which came to light were a significantly lower number responses in the Gw group, and a significant preponderance of human movement answe over colour answers on the Gw side (introversial) as against a significant preponderance colour answers over human movement answers on the Ew side (extraversial). Low outpu particularly when accompanied by constrictive signs, may imply pedantry, test consciou ness and paranoid trends; it may also imply depression. Considering the general conditio in Germany at the time of the testing (autumn 1948) it would hardly be surprising to fi depressive trends in the German group. The private life of the students was far from ros After all they had gone through during and immediately after the war they still had struggle hard for their maintenance, unrelieved from financial worries as were their mo fortunate English counterparts. Physical factors (general inertia, reluctance to make a effort) may also have played their part in preventing a greater productivity. One ma assume that the features which may be due to depression are at least to a certain exte temporary for the group and may disappear if the general conditions improve. On retests can show. This statement is apt to raise the question whether the Rorschach tes and with it the Experience Balance, perhaps reflects only a transient phase or whether reveals reliably some permanent aspects of a personality. Rorschach maintained that th Experience Balance may contract or expand owing to circumstances but that its gener direction, extraversial or introversial, remains the same at least for a considerable perio of an individual's life.[1]

Of the groups under discussion the Gw in their *EB* have shown introversive and the E extraversive tendencies, or, to use Rapaport(7) terms, the former would be more incline to 'thinking out', the latter to 'acting out'. Clinically, in extreme cases, the 'thinkin out' may lead to rumination and inhibition of action as seen in the obsessive compulsiv the 'acting out' to loss of control as seen in the hysteric.

If the attempt is made to assess the two main features within their setting and interpret the performances of the two groups as if they consisted of two individual recor the Ew group personality which seems to emerge may be taken to be less inhibited, mo outgoing than the Gw, and the emotional contact with the environment is stronger. Th Ew will be more flexible and more adaptable to circumstances. They may be inclined act on the spur of the moment, to experiment without thinking out all the details a consequences in advance. The danger of emotional lability is counterbalanced by th strong mature inner life (*M*) which acts as a stabilizing factor, makes for delay in actio and prevents what is commonly called 'losing one's head'. New problems in life will approached from different angles, sometimes at the expense of the obvious which may n always be seen easily. The Ew may be little concerned with details and perhaps not ve exact in their work. As a group they will be sociable and good 'mixers'.

The Gw showed themselves more inhibited and rigid with less emotional outlet. T affective link between their active inner life and outside reality is weak and they may fi

[1] In this connexion the hitherto unpublished results of an investigation by Dr George Day are of intere Dr Day tested 88 in-patients suffering from pulmonary tuberculosis on admission and re-tested them at interval varying from 4 to 24 months. Only six of them changed sides completely from introversial to ext versial or vice versa. (Quoted with the kind permission of Dr Day.)

hard to bridge the ensuing gap. The result would be that they might be more easily rown out of gear in a new situation. They would be more abstract in thinking and perhaps ore interested in first principles, although their approach to problems would be from the actical side. It is this practical approach and the grasp of reality which mitigates the neral aloofness. The Gw might be more reliable and painstaking, more exact as well as acting. Group cohesion may not be very strong and the members may be inclined to be ore particularistic.

V. SUMMARY OF RESULTS AND CONCLUSIONS FROM BOTH TESTS

ie results of two tests were presented and discussed:

(*a*) Attitude test results were obtained from 53 German women teacher-training students sted in Germany, and from 53 English teacher-training students tested in England.

(*b*) Group Rorschach results were obtained from 23 of each of the same two groups.

The Attitude test, besides confirming a number of well-known features in the respective lture patterns, showed that the Ew reacted in a more direct and objective way, and the w in a more indirect and subjective way. Although Jung's(4) terminology has been oided in order not to obscure the issue, one has only to call his general definitions of troversion and extraversion to mind and compare them with some of the responses to e that the mental mechanisms he describes fit the case:

Extraverted type. 'The orientation to the object and to objective facts is dominant.... terest and attention follow objective happenings'; Ew example from Qu.9: 'A fat liceman running behind a small boy and trying to catch him.'

Introverted type. 'Interposes a subjective view between the perception of the object d his own action.... Views the external conditions but selects the subjective deter- inants.... Relies on that which the outer impression constellates in him'; Gw example m Qu.9: 'She noticed that a young man she did not like very much was fond of her.'

Without following Jung into his complex system of functional types it seems on the rength of the test results safe to say that in so far as the subjective and objective aspects e concerned the Gw have shown themselves to be introverted and the Ew extraverted.

Further there was evidence that the Ew's objective and the Gw's subjective tendencies ere associated with a difference in the method of perceiving environmental stimulation, d it may be held that they were in fact due to that difference: the Ew's perception was tensive, the Gw's intensive, and it is worth remembering that Jung, when trying to find physiological explanation for his two attitude types, refers to Gross who described ysiological differences between individuals as 'shallow extensive' and 'narrow tensive'.

In the Rorschach test, apart from a significantly lower output of the Gw group, the other ain significant difference found was a prevalence of movement responses over colour sponses in the Gw group and a prevalence of colour responses over movement responses the Ew group. This, by definition, means that the Gw group was introversial or, in orschach's own words, 'less adaptive to outer reality and more intense', and the Ew oup extraversial or 'more adaptable to outer reality and more spread out than intense'. Thus the findings of both tests meet and agree.

No claim is made that these small groups are representative for their respective countries. the other sex, in other age groups, in other strata of society, in groups of different ographical or religious composition the results may be widely different. The groups were,

however, fairly similar in age, social background, level of education, momentary interes and vocation. The conclusions reached will be reviewed when the results of the whc investigation of which this experiment forms a part have been worked out.

VI. Supplementary material on the attitude test

Composite versions

The figures in brackets indicate the number of times the answer was given. Answers quoted verbatim a given in inverted commas. They are usually individual answers which are characteristic for a class answers.

German version.

Gertrud is thinking over a problem and writing her thoughts down (4). When the work is finished s ponders over it for a while (11) before she begins to wonder what to start next (7). Gertrud is a stude (29). She likes intellectual work for its exactitude and accuracy (5), for the mental effort it requires and for the possibility of getting an answer to the questions which puzzle her (5). There really is nothi she dislikes in it (10) unless the feeling that she will never be able to solve all the problems (6). When h teacher sees her work he will say that it is conscientious and thoughtful (8) and will admire her personali (6); he will think exactly the same (39), while she will be satisfied with her achievement (16).

Gertrud likes quiet reserved people (10) who are fond of nature, books and music (5), are independe in their views and steer a clear course (3), and she enjoys most the company of a kindred spirit (10), or intellectually superior people (10) so that she can learn something from them (2), and not of superfic folk (13) or muddled thinkers (5). At home they say that she is too withdrawn (5) and is overdoing t work (7) but she does not take any notice and carries on just the same (12). The other day there was argument about a philosophical problem (11). She stuck to her point of view and went out of the room (She is annoyed by personal interference (11) and lack of understanding on the part of others (5). Peo who are untidy (8) or who do not keep their promises and are late (6) can be very irritating to Gertru When she is angry she sometimes flares up (9), although it is better to walk it off or play the piano (Mostly, however, she keeps quiet (7), withdraws into her room (19) and ponders over the incident (7).

Not long ago she missed an appointment. She had been absorbed in her work (11). After all, wo comes first, of course. Gertrud is not frightened of anything (12), except perhaps failure (5) or what s may suffer at the hands of others (12). When she is tired she gets very depressed (24) and worries abo the uncertain future and where the money will come from for her study (9). There is still so much work be done, she has not carried out the day's programme (16) but it is no good, she may fall asleep any mome (7). What should she do? Sleep to be fresh for more work (10), 'set the alarm clock for early in the morning No, she will drink some strong coffee, freshen herself up and work still harder (18). She continues to tu things over in her mind (9).

It's a strange world these days when 'people one knows commit suicide in despair' and 'a fortune-tel told her the other day that she was to marry soon' (3). That was really funny, wasn't it? At night in h dreams she gets whatever she wants, money (5) and all the scientific books (5) she needs, complete wi shelves (2), a home of her own (5), her teaching certificate (4) and a good job (3). Once she thought s had £1000 and she immediately bought a house, furniture (24), books (9) and in her holidays went a journey (22) perhaps 'to the Black Forest'. Alas—it was a dream only. She was very disappointed (2 although she is resigned (13). It may be better as it is (3), 'money is not all—it is man's will that count In fact, she is satisfied with things as they are (24), she can 'adapt herself to anything'. Her aim in life success and a secure and satisfying position (28), and to 'become a personality who is loved and respecte It is towards this goal that she works unceasingly, sparing no effort in her training (29), studying improve (6), and loving and respecting her fellows (7).

Sometimes Gertrud wonders whether 'over her brain work she forgets reality' and she is afraid th she is too independent, ambitious and unwomanly (10).

English version.

Evelyn is writing (13). When she has finished she says 'thank goodness, this is done' (9). Will it satisfactory (11)? Anyhow, it is time to relax (11)—perhaps a cup of tea (4). Evelyn is a student (1 She likes her work because she is able to sit down while doing it (4), and because meeting so many differe people pleases her (6), but the lack of exercise and fresh air and the continuous reading are disadvantag (7). The tutor who sees her work will find it interesting (22) and will think that it could be better (

ther rambling and not always to the point—marking does take a lot of time'. Evelyn will feel that she ld have done better (11).

She likes friendly (7), active and sociable people (8) with a sense of humour (5) and interested in the rld in general (2), and dislikes noisy (6), boastful and bustling (4) folk who assert themselves too much She enjoys mixed company (14) most.

Life at home is not always peaceful. There was an argument because she did not take her share in mestic duties (3) and went out too much (5), and she realized she was wrong and gave in (9). Philo-hical problems gave rise to a discussion (11). They were argued out and an understanding reached (8). ise, in particular other people's wireless, annoys Evelyn (8) and so do bad manners (5) and unnecessary s (4). She can get very angry, changes colour (5), loses her temper (5) or speaks her mind and gets it her chest (5). Sometimes she just moves furniture and makes a lot of noise (2) or goes for a walk to tore the balance (7). Last week she missed an important appointment because she was late (4) and ssed the bus (10). She apologized, giving her reasons (10) 'although it sounded feeble'. Spiders, mice, ths, anything flapping round her face frightens Evelyn (24), also heights (4) and driving very fast (2). eeling of inadequacy (8) is another frightening experience. When she gets tired the unfinished work rries her (12) and the lack of energy (6) to 'complete little jobs'. She thinks of her work (7), and her lth (4), of old age and loneliness (2). People roundabout and noise become irritating (5). Something to be done about it. She does not try to work any more but either relaxes (14) 'in visiting some friends d playing games' or has a hot bath and aspirin (6) and goes to bed (22). Next morning the world looks ferent again. There are so many incongruous things to laugh at (17): 'the sight of the students doing T.' and 'the caretaker's wife, a rather rough person, calling for her daughter Hermione—how funny that very name sounds in her mouth!' Looking out into the garden Evelyn notices 'Two cats digging up ne plants Peggy had just finished planting—and Peggy is so over-proud of the garden!'

In her dreams at night Evelyn has all her wishes fulfilled. She has a husband, a home and family (18), ll varied life of work and play, and plenty of friends (15). £1000 are hers. She uses a part for gifts to people (14) and help for friends (11), travels abroad (13), buys furniture with some of it (6), and saves rest (16) for rainy days. Unfortunately, it was a dream only. It's disappointing (16) but it may come e one day (4). Evelyn is not satisfied with things as they are (42). She would like to see better condi-ns (5) 'higher wages and lower living costs'. She aims at helping wherever she can and furthering all orms which are useful (12), and she sets about it with a definite programme in mind (19) 'contacting al organizations, interesting herself in one of them and learning as much as she can about the members'. Secretly, however, Evelyn thinks she is selfish (6), and complacent (4) and lacking in drive (12), 'far m being a really useful member of the community'.

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PRIMARY SOCIAL ATTITUDES AND THE 'SOCIAL INSIGHT' TEST

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I. *Introduction* (p. 114). II. *Hypotheses to be tested* (pp. 114–116). III. *The Experiment* (pp. 116–11
IV. *Results* (pp. 119–122). V. *Conclusions* (p. 122). *References* (p. 122).

I. Introduction

In a series of studies (3,4,5,7), the writer has shown that social attitudes are organized very definite ways, and that the principles of organization can be investigated fruitful by means of factorial techniques. Attitudes, in this context, are defined as verbal respons to statements implying adient or abient reaction-patterns toward the issues or objec defined by the statement—Jews, Negroes, Nationalization, Death Penalty, Sund Observance, War, or whatever it might be. These responses are often of a stereotyp character (8), and can be shown to correlate significantly with objective indices of behaviou such as voting, or of status, such as income.

The main principle of organization in the field of social attitudes is well known; it is t factor of Radicalism-Conservatism, hereafter to be called the *R* factor. This factor w isolated by comparing the percentages of conservative, liberal and socialist voters w endorsed forty attitude statements, and by showing that the pattern of endorsements bo an almost one-to-one relation with the first factor extracted from a matrix of intercorre tions of the forty items calculated over all the subjects taking part in the experime ($n = 750$, divided equally into the three parties, and equated for age, sex, and educatio

The second dimension isolated is orthogonal to the first, and has not received mu attention from sociologists and social psychologists. It has been named provisiona Tendermindedness-Toughmindedness, and will hereafter be called the *T* factor. Both t *R* and the *T* factor are operationally defined in terms of those attitude statements whi have the highest saturations on the two factors. Fig. 1 gives a schematic diagram illustrati the position of various social attitudes in respect to the two factors; the actual questio used to define *R* and *T* are given below (p. 116–17).

II. Hypotheses to be tested

By and large, it may be said that radicals seek to effect changes in the existing order things, while conservatives on the whole seek to preserve that order. There are ma theories regarding the origin of these opposed sets of doctrines, ranging from Gilbert a Sullivan's nativistic belief

> that every boy and every gal
> that's born into this world alive,
> is either a little Liberal,
> or else a little Conservative,

to the more environmentalist explanations to be found in sociological writings. Here experiment has been set up to test two such hypotheses which have become rather popul among the more conservative and the more radical respectively. The *conservative hyp thesis* relates radicalism to emotional instability and neuroticism, by positing that to radical is to be maladjusted. There appears to be some indirect evidence in favour of su

hypothesis in the work of Lasswell (10), Krout & Stagner (9), and others, who show that dicals report less childhood satisfaction and more parental antagonism. However, erpretation of these data is difficult, and alternative interpretations are possible (6). ore direct evidence comes from the work of Rundquist & Sletto (11), who find a correlan of 0·326 between radicalism and the 'neurotic tendencies' section of the Bernreuter ventory for male, and one of 0·165 for female students. Altogether, they report that dicalism forms part of a general maladjustment factor, but again interpretation is ficult and generalization impossible because their work was done during the great

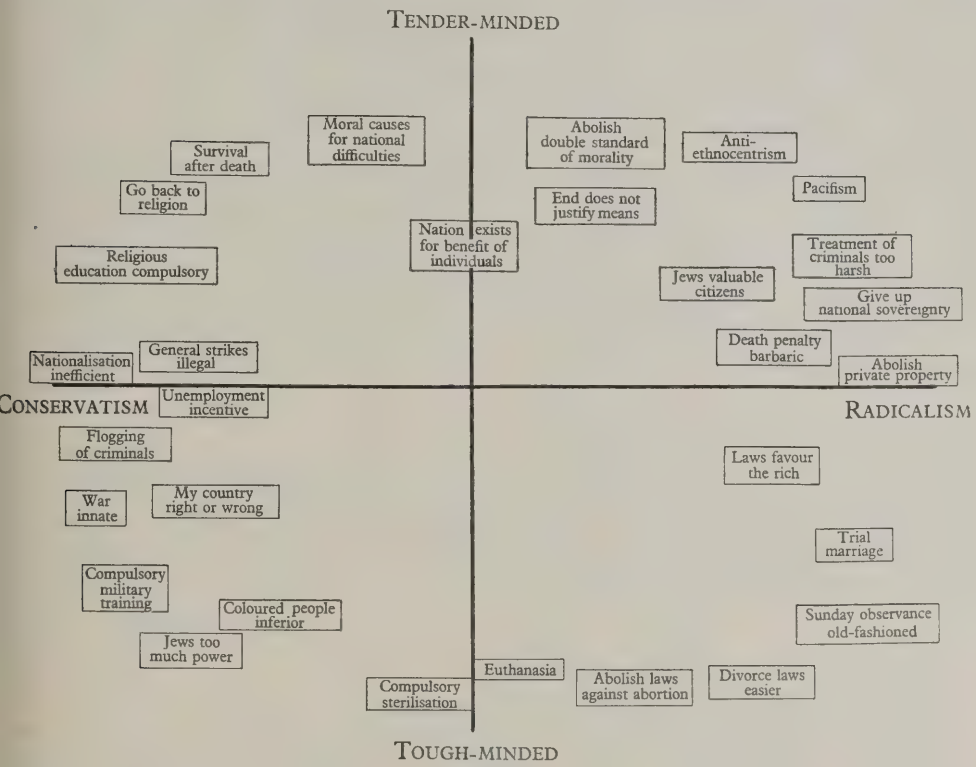

Fig. 1.

pression, and, in any case, might relate only to Americans and not to members of other ltural groups less closely identified with the capitalist system.

The *radical hypothesis* relates to cognitive rather than to orectic factors; it is based on e belief that the conservative is enabled to hold his attitudes only because he ignores cial facts which stare him in the face, either by not acquiring the necessary knowledge, by repressing what he knows. The fundamental point in this hypothesis would seem to ply that radicals would succeed better on a test of social insight than would conserva- es. 'Social insight' should not be confused with education or general knowledge; it plies a special awareness of social reality which may or may not be related to other types knowledge.

It might be possible to extend this general hypothesis by putting forward a subsidiary pothesis to the effect that *extreme* conservatives should be expected to have a highly ified and well-integrated system of social beliefs, and should therefore have more social

insight into this system of beliefs than would more moderate conservatives. It may b deduced from this hypothesis that the relation between radicalism and social insight woul be curvilinear, an hypothesis which can easily be tested.

III. The experiment

Two-hundred and thirty-three subjects altogether took part in the experiment. Their mea age was 35 years, with a S.D. of 11 years. Fifty-one per cent were men. Average education age (defined as age at which full-term education was terminated) was 17.10, with a s. of 2·83. The subjects were all urban, middle-class persons; the method of sampling use was identical with that described in an earlier publication (4). Conclusions cannot b generalized to working-class groups, or to rural groups.

These subjects filled in a number of questionnaires individually, under conditions strict anonymity. The questionnaires used were as follows:

(*a*) Forty-item 'Inventory of Social Attitudes'. It is from the answers to this inventor that the *R* and *T* scores for each individual are derived. Only fourteen items are used f each scale, and the items are partly overlapping. The construction, reliability, and validi of the scales has been reported elsewhere (4). The correlations of each item with *R* and *T* a given after each item; these are tetrachoric correlations using a 50-50 split on the continuo variables. The index of reliability for *R* and *T* respectively was +0·88 and +0·76. Mea scores were 5·82 ± 3·55 and 7·88 ± 2·45.

Inventory of Social Attitudes

Below are given forty statements which represent widely held opinions on various social questions, select from speeches, books, newspapers, etc. They were chosen in such a way that most people are likely to agree wi some, and to disagree with others. After each statement, you are requested to record your personal opini regarding it. If you strongly approve, put two crosses after it, like this: + +. If you approve on the whole, p one cross after the statement. If you can't decide for or against, or if you think the question is worded in su a way that you can't give an answer, put a zero, like this: 0. If you disapprove on the whole, put a minus sig And if you strongly disapprove, put two minus signs, like this: − −. Be sure not to omit any questions. T questionnaire is anonymous, so *please do not sign your name.*

Attitude statements	Correlation with *R*	Correlati with *T*
1. Coloured people are innately inferior to white people	−0·38	−0·14
2. The dropping of the first atom bomb on a Japanese city without warning was morally wrong and incompatible with our kind of civilization	0·30	0·06
3. Persons with serious hereditary defects and diseases should be compulsorily sterilized	−0·09	−0·58
4. Blood sports, like fox-hunting for instance, are vicious and cruel, and should be forbidden	0·37	0·14
5. Our present difficulties are due rather to moral than to economic causes	−0·24	0·26
6. In the interests of peace, we must give up part of our national sovereignty	0·73	0·23
7. Only by going back to religion can civilization hope to survive	−0·73	0·66
8. War is inherent in human nature	−0·60	−0·27
9. Sunday observance is old-fashioned and should cease to govern our behaviour	0·76	−0·52
10. It is wrong that men should be permitted greater sexual freedom than women by society	−0·03	0·19
11. 'My country, right or wrong' is a saying which expresses a fundamentally desirable kind of attitude	−0·48	−0·18
12. Our treatment of criminals is too harsh; we should try to cure, not to punish them	0·72	0·19
13. Ultimately, private ownership of the means of production and distribution should be abolished, and complete socialism introduced	0·76	−0·12
14. Workers in industry should have a voice in the running of their factory	0·36	0·08
15. Conscientious objectors are traitors to their country, and should be treated accordingly	−0·35	−0·14
16. The laws against abortion should be abolished	0·46	−0·67
17. The threat of unemployment is the only incentive which will cause people to work hard at unpleasant jobs	−0·50	−0·09
18. Jews are as valuable, honest, and public-spirited citizens as any other group	0·35	0·01
19. No unjust or aggressive war has ever been waged by England	−0·32	0·09
20. Compulsory military training in peace-time is essential for the survival of this country	−0·48	−0·14

	Correlation with R		Correlation with T
. People suffering from incurable diseases should have the choice of being put painlessly to death	0·20	.....	−0·50
. Children should be sent to boarding schools as young as possible to learn to stick up for themselves	−0·13	.....	−0·20
. Divorce laws should be altered to make divorce easier	0·57	.....	−0·68
. Crimes of violence should be punished by flogging	−0·70	.....	−0·22
. Under no circumstances can war ever be justified	0·30	.....	0·00
. The nationalization of the great industries is likely to lead to inefficiency, bureaucracy and stagnation	0·71	.....	0·09
. It is right and proper that religious education in schools should be compulsory	−0·71	.....	0·35
. Men and women have the right to find out whether they are sexually suited before marriage (e.g. by trial marriage)	0·47	.....	−0·61
. The principle 'Spare the rod and spoil the child' has much truth in it, and should govern our methods of bringing up children	−0·58	.....	0·20
. The end justifies the means, and it is often necessary to 'be cruel in order to be kind'	−0·40	.....	−0·16
. Our national life suffers from a lack of discipline	−0·39	.....	0·17
. The Japanese are by nature a cruel people	−0·57	.....	−0·20
. The Jews have too much power and influence in this country	−0·49	.....	−0·05
. The death penalty is barbaric, and should be abolished	0·68	.....	0·20
. 'General strikes' should be declared illegal	−0·71	.....	0·07
. Certain issues are so vital for a nation that war is preferable to submission	−0·32	.....	−0·15
. The nation exists for the benefit of the individuals composing it, not the individuals for the benefit of the nation	0·01	.....	0·28
. In war, one would be justified in torturing an enemy in order to extract important information from him	0·03	.....	−0·09
. The present over-emphasis on 'social services' makes people less self-reliant, and is therefore not in the best interest of the country	−0·60	.....	0·14
. There is no survival of any kind after death	0·53	.....	−0·54

Age ..... Sex .....

At what age did you leave school (or University)?.....

(*b*) A 'National Preferences Test', modelled after the Bogardus Social Distance scale. he order of the seven possible answers has been altered, in order to prevent the subject's eeing at a glance the principle on which these answers were originally chosen. The score or each nationality was the rank of the most favourable response given to that item sing Bogardus's rank order: i.e. from A, most favourable, to E, least favourable); the otal score on the scale was the sum of these numbers over all fifteen items. The index of eliability on this test was +0·97.

National Preferences Test

According to my first feeling reactions I would willingly admit members of each race (as a class, and not the est I have known, nor the worst members) to the classifications which I have encircled.

Be careful for each different nationality to encircle the letters signifying each classification to which you would dmit members of that particular nationality.

	To close kinship by marriage	To my street as neighbours	As visitors only to my country	To my club as personal friends	Would exclude from my country	To citizenship in my country	To employment in my occupation in my country
Americans	A	B	C	D	E	F	G
Germans	A	B	C	D	E	F	G
French	A	B	C	D	E	F	G
Italians	A	B	C	D	E	F	G
Jews (English)	A	B	C	D	E	F	G
Greeks	A	B	C	D	E	F	G
Russians	A	B	C	D	E	F	G
Negroes	A	B	C	D	E	F	G
Chinese	A	B	C	D	E	F	G
Irishmen	A	B	C	D	E	F	G
Indians	A	B	C	D	E	F	G
Englishmen	A	B	C	D	E	F	G
Poles	A	B	C	D	E	F	G
Turks	A	B	C	D	E	F	G
Jews (refugees)	A	B	C	D	E	F	G

(*c*) A specially constructed 'Social Insight Test'. The score on this test is simply th sum of the item scores, where a correct answer to the item is counted 2 points, a wron answer 0 point, and an omitted answer 1 point. The correct answers are known from th first investigation of social attitudes referred to above. The mean score on this test wa 18·69, with a S.D. of 2·89. The index of reliability was +0·79, which is too low for individua prediction, but probably sufficient for use with groups. A larger number of items woul presumably be required to increase reliability to a more satisfactory level.

Social Insight Test

It is sometimes possible to predict a person's opinion on a subject from knowing his political party. F instance, if you were asked if socialists or conservatives were more likely to be in favour of making general strik illegal, you would know that *conservatives* would be the right answer. Similarly, in the next question the righ answer is fairly obvious, and has been underlined.

0. Conservatives are more in favour of nationalizing industries.
   Socialists

By 'conservatives' we mean people *of your own social class* who vote conservative in a general election; b 'socialists' people *of your own social class* who vote for the Labour Party (we do not mean communists).

On some questions there are great differences between conservatives and socialists, on others there are on small differences, or none at all. On no question is there a complete divergence—there are always some conserva tives who agree with the majority of socialists, and some socialists who agree with the majority of conservative But there are usually tendencies in one direction or the other—socialists tend on the average to have one vie conservatives another. Read through the twelve test problems given below, and answer them by underlining wh you think is the correct response. If you think that there is no difference in attitude between socialists an conservatives, underline neither.

1. Conservatives
   Socialists — show stronger anti-Jewish feelings
2. Conservatives
   Socialists — have more lenient attitudes towards the upbringing of children
3. Conservatives
   Socialists — tend to be more religious
4. Conservatives
   Socialists — are more opposed to capital punishment
5. Conservatives
   Socialists — believe that in the interests of peace we must give up part of our national sovereignty
6. Conservatives
   Socialists — are more in favour of equal pay for men and women doing the same work
7. Conservatives
   Socialists — believe that workers in industry should have a voice in the running of their factories
8. Conservatives
   Socialists — believe that coloured people are innately inferior to white people
9. Conservatives
   Socialists — are more in favour of flogging as a punishment
10. Conservatives
    Socialists — believe that our present difficulties are due to moral rather than to economic causes
11. Conservatives
    Socialists — believe that it is wrong that men should be permitted greater sexual freedom than wom
12. Conservatives
    Socialists — believe that war is inherent in human nature

(*d*) The 'Crown Word Connexion List'. This is a forced-choice word association test, which the score is the number of neurotic response words chosen. (The efficacy of th choices was established in each case on large groups of normals and neurotics; the reli bility and validity of this test as a measure of neuroticism are high enough for group wor though not for individual diagnosis (1).) The mean score for the group was 7·22, with a S.D of 4·96.

Word Connexion List

Below you will find a list of familiar words printed in capital letters, each followed by two words in small letters. ok at the word SINK in the example below. Now glance at the two other words. Does the word SINK make u think more of 'wash' or of 'drown'? Draw a line under whichever word is more connected in your mind h SINK.

EXAMPLE: SINK wash drown

Some people connect 'wash' with SINK and so they underline 'wash' as follows: SINK wash drown. Other ple connect 'drown' with SINK and therefore they underline 'drown' as follows: SINK wash drown. There no right or wrong answers because one word connexion is just as good as another. Just look at the two words t follow the word in capital letters and underline the one that *you* feel is more connected in your mind with that rd. WORK FAST. Don't stop to think long about any one word. Be sure not to leave any words out.

SCISSORS	nurse	cut	WEIGHT	scale	losing
HANDS	feet	moist	DIGNIFIED	snobbish	poised
LOUD	yell	soft	TALKED	spoke	about
WOMAN	girl	trouble	SLEEP	nightmares	bed
LION	eat	tiger	RIVER	lake	danger
LIGHT	dark	sentence	BABY	foundling	little
BLUE	sad	sky	LOSE	find	mind
STOMACH	food	ache	SALMON	dislike	like
LEFT	home	right	HUNGRY	thirsty	heart
THOUGHTS	ideas	strange	MAN	hard	boy
SLOW	beware	fast	MUTTON	eat	flesh
BOY	girl	mischief	SWIFT	hurricane	slow
SHORT	little	tall	BRING	take	disaster
CONTENTED	happy	discontented	SWEET	affected	bitter
FAIRY	shameful	wand	FOOD	stomach	poisoned
UNHAPPY	no	yes	RAW	deal	meat
THIRSTY	dry	drink	PARTY	crowd	myself
EATING	drinking	fasting	BITTER	medicine	sweet
FEEL	useless	good	GRAVE	serious	funeral
HEAVY	weight	heart	WOMAN	excitement	man
TROUBLE	lawyer	sorrow	SOUR	lemon	stomach
DEEP	ocean	hurt	CAN'T	concentrate	fly
FRIEND	double-crossed	close	PINT	quart	whiskey
FOOT	hand	tingle	NEEDLE	drug	sharp
MAN	work	woman	WOUND	bandages	feelings

Remember: There are no right or wrong answers. Go as fast as you can.

(*e*) Scores for attitudes of War-mindedness and of Anti-semitism were derived from a mbination (equal weighting) of items 25, 36, and 6 for the former, and items 18 and 33 for e latter in the Inventory. These combinations had been shown elsewhere to be good easures of these two attitudes respectively (2).

(*f*) An emphasis score (E score) was also derived from the Inventory of Social Attitudes, summing items for each subject on which an extreme (+ + or − −) answer had been ven, regardless of the direction of the answer. An average score of 14·03, with a S.D. 8·03 was found; the index of reliability was 0·94.

IV. RESULTS

e various tests described in the previous section were intercorrelated, and the results e reported in Table 1. Product-moment correlations were used, except for the item 'Sex', ere Biserial r was used instead. The number of subjects was only 191, as not all subjects ve scorable responses for each of the items correlated. A factorial analysis was performed d two factors extracted from the matrix of intercorrelations. These are given in Table 2. e results are given in diagrammatic form in Fig. 2. It should be noted that the satura- ns reported are not the original centroid factors, but represent factors rotated through angle of 47° so as to pass through (or as near as possible to) the locus of R and T pectively, these points having been established in our previous work, and thus serving identify factor axes in the present research.

The following points may be noted. (1) R and T are almost entirely unrelated, the slightly obtuse angle between them indicating a negative correlation of −0·12. (2) The Social Insight Test is positively related to the R factor, but has no relation at all to the T factor; this finding supports the *radical hypothesis*. (3) The Word Connexion List, our

Table 1

	No.	1	2	3	4	5	6	7	8	9	10	11
Physical age	1	—	0·263	−0·089	0·002	−0·160	0·095	0·113	−0·036	−0·019	−0·227	0·0
Sex (male)	2	—	—	−0·049	0·083	−0·040	0·075	0·045	−0·006	−0·019	−0·144	−0·0
Educ. age	3	—	—	—	0·004	0·013	0·050	−0·131	−0·172	−0·048	0·124	0·0
Emphasis	4	—	—	—	—	−0·043	0·052	0·093	0·022	0·024	0·013	−0·1
Pro-semitism	5	—	—	—	—	—	−0·164	−0·403	0·034	0·372	0·127	0·1
War-mindedness	6	—	—	—	—	—	—	0·221	−0·072	−0·274	−0·157	−0·1
Ethnocentrism	7	—	—	—	—	—	—	—	−0·021	−0·301	−0·172	−0·2
Word Connexion List	8	—	—	—	—	—	—	—	—	0·106	−0·152	0·0
R	9	—	—	—	—	—	—	—	—	—	−0·105	0·2
T	10	—	—	—	—	—	—	—	—	—	—	0·0
Social Insight	11	—	—	—	—	—	—	—	—	—	—	—

Table 2

Test variable	Factor I	Factor II
1. Age (reversed)	0·50	−0·05
2. Sex (female)	0·37	−0·03
3. Educational age	0·18	−0·18
4. Emphasis (reversed)	0·07	0·08
5. Anti-semitism (reversed)	0·30	0·46
6. War-mindedness (reversed)	0·25	0·34
7. Ethnocentrism (reversed)	0·34	0·53
8. Word Connexion List	−0·18	0·15
9. Radicalism	−0·06	0·62
10. Tender-mindedness	0·46	−0·07
11. Social Insight	0·04	0·43

Direction of scoring of same items has been reversed so as to bring as many of them as possible into the first quadrant, as shown in Fig. 2.

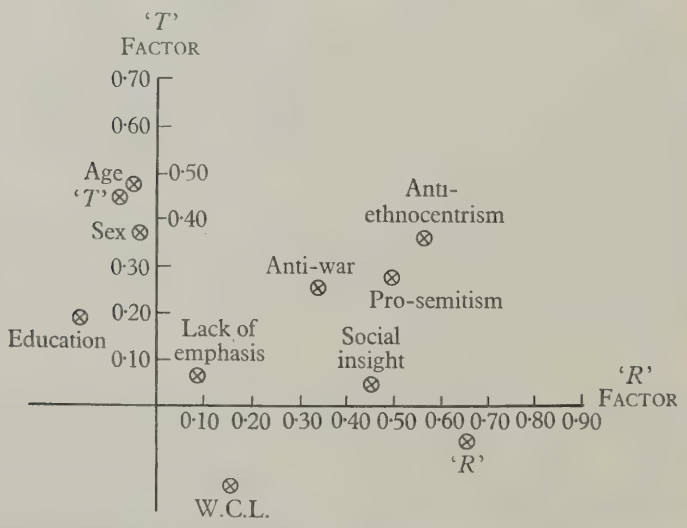

Fig. 2. First quadrant in R–T two-factor space; to correspond with first quadrant in Fig. 1.

measure of neuroticism, instability, or maladaptation, shows no significant relation to R; this finding disproves the *conservative hypothesis*. (It should be noted that this negative result is not likely to be due to the lack of reliability or validity of the Word Connexion List; elsewhere it has been shown that highly significant correlations exist between

roticism as measured by it and such social attitudes as anti-semitism and war-ndedness(2).) (4) The correlation between the Word Connexion List and T is too low to considered significant ($r = -0{\cdot}152$), but it should be noted that in a previous research(2) milar correlation was found ($r = -0{\cdot}137$). Taking the results together, they suggest a high level of confidence that neuroticism is correlated with tough-mindedness. Education shows no significant relation to either R or T, showing that social insight is to be confused with general level of knowledge or education. (6) The position of the nocentrism, anti-semitism, and pro-war tests is in line with previous work, and shows influence of R and T to an almost equal extent. (7) The position of sex is also in line with vious work, where women were shown to be more tender-minded, and neither more nor radical than men. (8) The relatively high saturation of age with the T factor is a prise, and may be due to the high sampling errors of residual correlations; it is not in with previous work indicating that age as such was not conspicuously related to either r R.

n view of the significant relation between social insight (to be called 'S') and R we may cuss the experimental data related to this test in a little more detail. In the first place, question of linearity of regression arises—it will be remembered that one of our sidiary hypotheses called for a curvilinear regression between these two variables. The erved value of η_{SR} is 0·45, which is significant at the 1% level, and significantly higher n the product moment correlation at the 5% level. We may say, therefore, that our diction has been verified.

Next we may list in detail the scores of three groups of subjects on the 'Social Insight' , graded according to their R scores. Group I comprises 67 *Ss* with R scores ranging n 0 to 3; this will be called the conservative group. Group II comprises 89 *Ss* with R res from 4 to 7; this will be called the intermediate group. Group III comprises 77 *Ss* h R scores from 8 to 14; this will be called the radical group. The percentages of items rect, omitted, and incorrect are given in Table 3 for these three groups separately. We y give each group a score for each item by subtracting the 'per cent incorrect' from the r cent correct'. The overall scores of the three groups are then 48% for the conservative, % for the intermediate, and 64% for the radical group, showing again the superiority he radical group.

Table 3

	Group I			Group II			Group III		
n no.	Correct	Omitted	Incorrect	Correct	Omitted	Incorrect	Correct	Omitted	Incorrect
1	0·299	0·418	0·284	0·472	0·416	0·112	0·649	0·273	0·078
2	0·657	0·224	0·119	0·472	0·427	0·101	0·532	0·442	0·026
3	0·701	0·298	0·000	0·573	0·382	0·045	0·610	0·364	0·026
4	0·866	0·060	0·075	0·776	0·157	0·067	0·766	0·130	0·104
5	0·910	0·090	0·000	0·843	0·146	0·011	0·857	0·143	0·000
6	0·672	0·298	0·030	0·888	0·090	0·023	0·896	0·104	0·000
7	0·716	0·224	0·060	0·865	0·124	0·011	0·961	0·026	0·013
8	0·403	0·507	0·090	0·641	0·337	0·023	0·792	0·208	0·000
9	0·657	0·313	0·030	0·663	0·326	0·011	0·779	0·221	0·000
10	0·567	0·269	0·164	0·348	0·551	0·101	0·494	0·416	0·091
11	0·075	0·701	0·224	0·236	0·663	0·101	0·286	0·558	0·156
12	0·403	0·537	0·060	0·393	0·573	0·034	0·545	0·455	0·000

A discussion of the individual items is somewhat hazardous, as differences between them y be due to chance; only a repetition of the experiment could show the existence of any inite tendencies. One exception to this rule relates to the order of difficulty of the items; three groups are apparently in close agreement on this issue, with correlations between

0·6 and 0·9. Items 11, 1 and 10 are the hardest, and items 6, 7 and 5 are the easies Items 12, 2, 8, 3, 9 and 4 are intermediate, in that order. The most diagnostic items, a far as correlation with R is concerned, are items 1, 7 and 8; the least diagnostic are item 4, 5 and 9. Difficult items may thus be a little less diagnostic than easier ones, but th data certainly justify no more than a guess to this effect.

It will be noted that the conservative group has particularly little insight into the fac that conservatives are anti-semitic and consider coloured people inferior, suggesting th possible operation of repression as a defence mechanism against the acceptance of un pleasant truths. Conservatives show most insight with respect to their approval of capita punishment and flogging, where no such general social disapproval exists as in the case o ethnocentrism and anti-semitism. Here appears to be a fruitful field for further research our data do not allow us to go further than this.

V. Conclusions[1]

Two hypotheses were examined in this paper, relating to concomitants of radicalism. Th hypothesis linking radicalism with emotional instability was decisively rejected by th data. The hypothesis linking radicalism with a high degree of social insight was borne ou at a high level of confidence. This relation was shown to be curvilinear, extreme conserva tives showing better scores than less extreme conservatives and liberals, but not scoring a highly as radicals. Social insight was found to be independent of education.

The relation between the variables studied was clarified by a factorial analysis of the interrelations. In the main, this analysis bore out previous studies into the factor determining social attitudes and showed the position of 'social insight' and 'emotion instability' with respect to two primary social attitudes.

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[1] Since the above paper was completed, *The Authoritarian Personality* by T. W. Adorno, E. Fren Brunswick, D. J. Levinson and R. N. Sanford (New York: Harper Bros. 1950) has come to hand. It stror supports many of the conclusions drawn here and is of particular interest as it relates to a different cult pattern.

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THE ABILITY OF THE GURKHA RECRUIT

By F. W. WARBURTON

Introduction (p. 123). II. *The general background* (pp. 123–124). III. *The level of test performance* (pp. 124–125). IV. *Attitude to testing* (pp. 125–126). V. *Educational level of the recruits* (pp. 126–127). VI. *The experimental test battery* (pp. 127–128). VII. *Factor analysis of the results* (pp. 128–130). VIII. *Validities and reliabilities* (p. 130). IX. *The selection test batteries* (p. 130). X. *The influence of length of Army service* (p. 131). XI. *Tribal differences* (pp. 131–132). XII. *Conclusions* (pp. 132–133). XIII. *Summary* (p. 133).

I. Introduction

This paper describes a research on the construction of selection tests for allocating Gurkha recruits to various Army employments.

The man-power shortage following the end of the war made it desirable that Gurkha formations should supply their own ancillary troops, such as artillery, sappers and signals. Previously they had served entirely as infantry. In view of this change in organization, a research team was sent from the War Office Selection Centre to Malaya to introduce selection procedures for recruits. Much of the work lay in the standardization of the test material, and during the tour twelve tests were tried out and over 1200 men were tested. In the main experiment, which was carried out with the 22nd Battalion at Ipoh, 400 men were tested in seven performance tests. Owing to active service conditions, only 124 men performed the final version of the Dice test.

II. The general background

The Gurkha comes from Nepal, an independent state on the north-east Indian frontier. It is a mountainous country in the Himalayan region, Mount Everest lying partly within its borders.

The independence of Nepal is not entirely nominal, since communications with India are extremely poor. A narrow-gauge railway, built in 1927, takes one for the first 25 miles of the journey to the capital, Khatmandu. After that, the road runs through the terai, a malarial swamp dangerous to Europeans for several months of the year, traversed to-day by 'wheezing, swaying, terrifying buses'. As the mountains are crossed the road becomes impassable to wheeled traffic and the traveller is so impeded by deep ruts, boulders and rivers that even ponies may be used only with difficulty.

The Central Valley, in which the capital lies, is some 15 miles square and contains about half the population of the country, which is said to be $5\frac{1}{2}$ millions. Here, to summarize the travel books, is a fairly advanced civilization of merchants, artisans and cultivators. There are nearly 3000 temples and shrines, either Buddhist or Hindu, in the Valley, and the quality of much of the architecture, woodwork and metalwork is high. There are a few schools, and a library which is a repository of Sanskrit literature. Wheeled traffic is rare. There are only a few carts pulled by buffaloes. The rule is to walk or to be carried in dandy, litter or basket. Only officials or foreigners may ride ponies up to Khatmandu. In other parts, it is possible to have mules or ponies, but they are rarely used except by invalids. No foreigner may enter Nepal except by official permission, which is given only for journeys to the capital.

In some parts of the countryside there is intensive but very primitive farming. A fe of the natives trek to India during the autumn and get work as dockers or porters Bombay, returning in the spring with cloth, salt and goods bought from their savings.

The Army does not recruit directly from the Central Valley although a few of i inhabitants who have migrated elsewhere, find their way in. Recruiting is confined the clans from the highlands. Men are brought in by parties of Gurkha soldiers sent in the mountains for that purpose. Recruits come for the most part from areas whe a hard living is scratched from the soil with a primitive plough. It is a privilege to jo the Army and recruiting is not difficult.

In appearance the Gurkha is more Mongol than Indian, especially if he comes from t eastern region. In temperament, to quote a writer of a hundred years ago, 'he is phle matic and slow in intellect and feeling, but good-hearted, cheerful and tractable'. Capta Morris, writing in 1933, in the official handbook on the 'Gurkha Soldier', says: 'He a simple soul, clean living, intensely fond of his mountain home, fearless and brave.. He is outspoken at all times and does not know the flattery so much practised in the East

The Gurkha religion is a fusion of Hinduism and Buddhism; Buddhist lamas a employed by some of the tribes on the more important religious occasions. The ma feast of the year is the ten-day long Dashera, a succession of tribal dances and dramat interludes, at which a sacrificial offering is made of pigs, goats, bulls and you buffaloes, the head being completely severed with one blow of the sacrificial kukri. The have some food taboos, but they are not so rigid in their observance as the orthod Hindu. The men sometimes see ghosts, and after dark they prefer to do their duty in pai

Their manners and customs vary widely, however, since recruits are drawn from a lar number of isolated clans, some of them living 500 miles apart.

III. The level of test performance

The first task was to get some notion of the level of Gurkha test performance. It was so obvious that standards were very low indeed. A direct comparison was made with Briti norms by taking a sample of 30 British soldiers, exactly representative, according to th test grades, of the Army as a whole.

These 30 men were given the same tests as the Gurkhas, and British norms were dra up for the Gurkha test battery. The results were:

Table 1. *Comparison of scores of British and Gurkha recruits*

		Percentage of Gurkha recruits						
British Grade	Percentage of British soldiers	Screw board (manual dexterity)	Colour Series	Dice	Form board	Cube Conn.	Nail board	Bloc desig
1	10	1·5	1	0	0·5	0	0	0
2	20	1·5	1	0	0·5	0	0	0
3+	20	28	4	2	0·5	0	0	0
3−	20	9	10	4	0·5	13	2	1
4	20	23	41	4	11	25	12	8
5	10	37	43	90	87	62	86	91
Above British median	50	31	6	2	1·5	0	0	0
Below British median	50	69	94	98	98·5	100	100	100

Gurkha performance is thus very considerably below British standards. In the combined ests, less than 2 % score above the British median.

An apparatus form of the Progressive Matrices 1938 test was also given to Gurkhas of ery superior ability, i.e. those placed in the top 1% of the population as judged either by ntelligence tests or by ratings made by their company commanders. There were ten of hese men, and not one of them reached the British median. Their average score was 25·2, vhich lies on the borderline between grades 4 and 5, i.e. at about our 10th percentile. Those in the top 1% of the Gurkha population therefore are thus likely to rank about 0th in a typical sample of 100 British soldiers.

IV. Attitude to testing

People brought up in a less competitive environment than our own do not necessarily ive a true indication of their ability under testing conditions. They are not accustomed o concentrate on an abstract task. Nor are they likely to desire very strongly to succeed n it.

The most striking thing about the recruits was their lack of pep and slowness of move- nent. They just plodded solemnly along. The slow, deliberate manner in which they andled the apparatus made a striking contrast to the hurried scampering of the British roops. On the other hand, if they thought that speed was the main requirement of the est, as some of them did in the early stages of the experiment, they jumbled all the pparatus together in a nonsensical way and finished in record time. One man ompleted the Matrices test (60 questions) in 7 minutes, and scored just above chance. n general, however, they were extremely slow.[1] For this reason the ideal intelligence est for them would have no time limit. Although this is not practicable in group testing, ufficient time was given wherever possible for a large number of the men to finish the ask.

The Gurkha recruits listened to the instructions attentively but with completely notionless faces. In this respect they were markedly different from any British group, ntelligent or unintelligent. Whilst performing the tests they rarely looked at one another r smiled.

Morale was high. No one appeared to sulk because he was unable to answer all the questions. No one quarrelled with his neighbour. The general attitude was one of amiable co-operation.

The recruits were not curious about being tested and had little insight into the reasons for the experiment. No one asked the officer or N.C.O. why he was expected to busy himself with building bricks and jig-saws. It was typical that, because most of the apparatus was made of wood the psychologist was known as the wood officer.

There was every indication that they were doing their best. The proportions of right and wrong answers followed the usual patterns. They were completely absorbed in the

[1] Klineberg reports the almost complete lack of speed shown by the reservation Indian or the rural southerner. He can see no reason for hurrying through a task, especially if he does not find it congenial and interesting.

Biesheuvel found that a high pitch of concentration while working at full speed does not come easily to the African in whose culture speed plays no part, who likes to take his time over things, who is seldom called upon to concentrate his thoughts on one problem to the exclusion of everything else and is never required to combine speed with concentration for a long time without some relaxation of effort.

task. It was plain that, whatever the impress of their earlier environment, we we getting a measure of their maximum efficiency in answering the test questions.[1]

V. Educational level of the recruits

Another major factor, which had to be taken into account when planning the researc was the primitive home environment of the recruits. A small proportion (1% or s chiefly soldiers' sons, had received some schooling in India but their educational lev was generally below that of the British primary school and they were almost all en ployed as routine clerks.

The ordinary Gurkha, however, comes from a very isolated community. Befo enlistment he has had no schooling. He does not know how to hold pen or pencil. Writt tests are far too difficult for him. In other ways, even the simplest pencil and paper te would not be fair to him. It would be surprising if he were free from feelings of incon petence when faced with a book since reading is something which others can do and cannot. He would feel that he was being taken at a disadvantage if made to work o tests in book form.

The use of pictorial tests was considered but had to be given up, partly because t recruits often failed to recognize pictures even of those objects which they knew qui well,[2] and partly because one could not be certain to what extent their previous experien and opportunities had been the same. It was clearly necessary to use performance tes despite their limitations.[3]

[1] This is not always the case. In the testing of negro recruits in the United States Army, for example, Yer reports that it took all the energy and enthusiasm that the examiners could muster to maintain the necessa attention as there was a decided disposition for the negroes to lapse into inattention and almost into sleep.

[2] Biesheuvel considers that pictorial tests overlook the fact that the picture, particularly when printed paper, is a highly conventional symbol, which the child reared in Western culture has learned to interp because he is confronted with pictures from his earliest days. He gets much of his pre-school education fr picture-books and toys with pictures on them, and is encouraged to draw pictures for himself. It was fou that very few African mine-workers could identify the picture of a hut, a pot or a pan with which they w familiar.

[3] Biesheuvel points out that 'the non-European with a limited scholastic background has some difficulty understanding the purport of the figures and designs presented in these tests, despite the fact that he u abstract designs in decorating the walls of dwellings or objects in daily use and in making beadwork or ot ornaments. In daily life such designs are part of the objects decorated and are never seen as entities by the selves. Though obviously they are constructed piece by piece and step by step, the pattern as a whole and relation to the object decorated is no doubt present in the mind of the decorator all the time, it is unlikely e to be studied analytically or to be built up into an aggregate or mosaic of separate units. That, however, is task which is set in virtually all the tests using diagrammatic or pattern material; meaningful wholes in te of background-foreground, articulation, good concentration, good shape, etc. are ignored and the closure princ may have only limited application. Most of the patterns in the Matrix test, for instance, have a logical ra than an organismic unity. The use of patterns and colours drawn from native culture had no noticeable ef on test performance, presumably because the test situation demanded an attitude or perceptual habits, naturally associated with those patterns in their proper context....

'In our European culture orientation with reference to the four main points of the compass or to the vert horizontal axes of the body are taken for granted. We take rectangularity in our buildings, in the positio windows, in our books and writing paper, very much for granted. The African domestic servant, however, dusting the pictures on the walls tends to leave them at any odd angle without noticing anything wr Position within space as a separate entity is not, as a rule, abstracted from his holistic perception of rea Hence tests which assume this habit of mind, or which require facility in this mode of thinking place the European, who through lack of early contact with European culture has not acquired this analytic appro at a distinct disadvantage....

It is possible that the thinking of the native is holistic, rather than analytic, that their mental processes

The same difficulty was met in devising tests of practical ability. On enlistment the ecruit is completely unfamiliar with things mechanical. He does not know which is the ront end of a bicycle. He has never turned a door knob. In some cases he has never seen wheel.

Standard tests of mechanical ability cannot be used, since the recruit has no clear icture of the requirements of the task. To assemble mechanical devices, such as locks r spanners, the subject should have some knowledge of their uses and appearance when ompleted. Otherwise the whole character of the test is changed, although it might onceivably be used as a test of spatial perception or manual dexterity. A simple nechanical assembly test was tried out but no recruit succeeded in assembling an object orrectly.

A great deal of time was spent discussing their home life with the men, but there was ot a sufficient measure of agreement among them to form a basis for constructing a group est. The construction of an assembly test based on agricultural and building implements sed in Nepal was also considered. They use only the simplest tools, however, and con-tructional work is largely in the hands of certain castes. Nor is it by any means certain hat such a test would be suitable. It is not known whether acquired skill in assembling Eastern agricultural or building implements is highly correlated with trainability in ssembling Western mechanical devices. The usefulness of such a test is a matter for long-erm research beyond the scope of the present experiment.

VI. The experimental test battery

Following the practice of the British Army, a scheme was required for drafting the men nto one of several categories of work. These were: (1) Technical, e.g. radio mechanics; 2) Clerical, including storemen; (3) Mechanical Trades, e.g. vehicle mechanics, engine itters; (4) Non-mechanical Trades, e.g. bricklayer, carpenter; (5) Mobile, pioneers, etc.; 6) Driving; (7) Domestic: batmen, sanitary orderlies, stretcher-bearers.

Some of these groups are, of course, highly skilled, so that at the moment the scheme s somewhat idealistic. However, a small proportion of the recruits had received some chooling in India. Some of them could presumably manage skilled work if given thorough ourses of instruction. Before a recruit can satisfactorily be placed in one of these even categories, it is obvious that he should be graded not only for general intelligence ut for other abilities as well, including practical ability.

The most difficult problem of the research was to distinguish between general intelligence nd practical ability when the use of a mechanical assembly test was precluded. It seemed est to regard practical ability as comprising (i) spatial discrimination, and (ii) manual exterity, and to try to measure these two abilities separately. After preliminary trials ith several tests, seven were chosen for further investigation. These were of a suitable

owards the minimum simplicity of complete uniformity rather than the maximum simplicity of perfect rticulation', two concepts discussed by Koffka in his analysis of perceptual organization, or that their mental unction is integrated rather than unintegrated, as defined by Jaensch. 'Only impressionistic evidence is available n this non-analytical element in the thought processes of Africans and no evidence at all as to whether its origins re genetic or cultural'. Biesheuvel suggests that the Gottschaldt Figures Test may be more appropriate for se with natives, since it measures a closure factor, more particularly flexibility of closure or the ability to destroy ne Gestalt in favour of another. In dealing with patterns, where figure-ground articulation is an essential lement this factor should be important, since it demands a synthetic or holistic rather than an analytic esponse.

level of difficulty and the complete battery was designed to give estimates of (i) gener intelligence, (ii) spatial ability, and (iii) manual dexterity.

1. *Dice.*[1] This is a number series test, very similar to the Dominoes test at present us by the British Army as a non-verbal test of intelligence. The subject is presented wi a board, on the back and front of which are drawings of twenty rows of dice, each ro constituting a series such as 1, 2, 3, 4, 5 or 1, 6, 1, 6, 1, 6, or 1, 6, 2, 5, 3, 4. The subject h a number of loose dice and completes the series by dropping a die, the right way up, in a slot at the end of the row. This test has the practical advantage that each die provid six alternative answers.

2. *Colour Series.* In this test the subject is presented with rows of blocks arranged colour sequence. The task is to complete the series by adding loose blocks to the row.

3. *Block Design.* A simplified version of Koh's Blocks.

4. *Cube Construction.*

5. *Nailboard.* This is a tracing test. The subject is presented with a number of zigz lines printed on a board. Beside each of these lines is a network of small holes. The ta is to reproduce the lines by placing the nails in the appropriate holes.

6. *Circular Formboard.* Comprising eighteen separate circles.

7. *Screwboard*, a test of manual dexterity in which the subject has to screw 25 nu on to bolts. It has the advantage of being an operation commonly required in standa assembly tests.

There was one important way in which the testing routine had to be changed. became apparent quite early in the experiment that the usual method of giving standardiz test instructions was not suitable. However thorough the formal instructions given the tester, a large number of the men still had no idea how to begin. The best meth found was to provide the tester with short instructions covering all the points whi had to be known to the men, and to set up a class of instruction in a corner of t room. This lasted for 10 minutes or more, until the tester was satisfied that every m knew how to set about the task. This was ensured by making each man work out pract examples and by checking them individually.

The test patter was given in Gurkhali by Gurkha N.C.O.'s to groups of 12 or 13 me

VII. Factor analysis of the results

Table 2. *Correlation Matrix*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) Screwboard	—	0·171	0·263	0·199	0·210	0·160	0·112
(2) Formboard	0·171	—	0·287	0·353	0·298	0·323	0·134
(3) Nailboard	0·263	0·287	—	0·594	0·463	0·419	0·304
(4) Block Design	0·199	0·353	0·594	—	0·484	0·429	0·351
(5) Colour Series	0·210	0·298	0·463	0·484	—	0·338	0·332
(6) Cube Construction	0·160	0·323	0·419	0·429	0·338	—	0·199
(7) Dice	0·112	0·134	0·304	0·351	0·332	0·199	—

[1] The 1938 Progressive Matrices test was tried out as a test of general intelligence. The conclusion was a very simple version of this test could be devised which would give satisfactory scatters, provided it presented on cards. In difficulty, it should not go beyond the middle part of Set B of the standard versio

It was decided not to proceed with the construction of this test since with this method of working, and at level of difficulty, the spatial and perceptual content would probably be higher than in the full test. Sinc object of trying out the Matrices had been to obtain a test of pure intelligence, it was omitted from the ex mental battery.

An analysis was carried out by the method of maximum likelihood (three iterations) s follows:

Table 3

	I	II	III	
Dice	+0·441*	+0·291*	+0·096	
Colour Series	+0·637*	+0·076	+0·069	
Block Design	+0·779*	+0·066	−0·078	
Nailboard	+0·738*	−0·007	+0·040	
Formboard	+0·452*	−0·208	−0·095	
Cube Construction	+0·568*	−0·171	−0·160	
Screwboard	+0·321*	−0·232*	+0·357*	
Percentage variance	34·02	3·16	2·63	=39·81%

* Significant at 0·05 level.

Since the test battery was confined to performance tests, it seemed likely that the eneral factor was a composite of general intelligence, spatial ability and manual dexterity, nd that a clearer picture would be obtained by rotation of the axes. This was done by ne method of extended vectors. The general principles were to keep all loadings positive r zero, to have as many low loadings as possible, and to use correlated factors. We were ooking, in other words, for an interpretation similar to, but less exacting than simple tructure.

Table 4. *Factor loadings*

(Loadings less than 0·100 in brackets)

	Pattern on the primary factors		
Test	*X* (k)	*Y* (g)	*Z* (m)
Dice	(0·004)	0·535	(0·001)
Formboard	0·463	(0·002)	(0·084)
Cube Construction	0·566	(−0·079)	(0·016)
Screwboard	(−0·003)	(0·001)	0·535
Colour Series	0·263	0·410	0·121
Block Design	0·481	0·441	(−0·001)
Nailboard	0·393	0·371	0·152

Table 5

Percentage direct and joint contribution of factors

	X (k)	*Y* (g)	*Z* (m)
X (k)	14·14	—	—
Y (g)	6·58	11·34	—
Z (m)	2·07	1·13	4·73

=39·99%.

Correlations between the primary factors

	X (k)	*Y* (g)	*Z* (m)
X (k)	1·000	0·452	0·470
Y (g)	0·452	1·000	0·373
Z (m)	0·470	0·373	1·000

The Dice and Colour Series tests are, on *a priori* grounds, clearly the most abstract and east spatial tests in the battery. One would expect them to have high 'g' and low 'k' aturations. They both have high loadings on the second rotated factor, whereas the Screwboard and Formboard have zero loadings (Table 4). This factor has therefore been nterpreted as 'g'.

The first rotated factor has high loadings in the Cube Construction and Formboard ests, and zero saturations in the Dice test (Table 4). It has been identified as 'k', spatial bility.

The third factor has a high loading in one test only, the Screwboard. In all other test except the Nailboard and Colour Series, it has zero, or near-zero loadings. It has bee taken as 'm', manual dexterity.

The relatively high loading for manual dexterity in the Nailboard had not been for seen. It was very useful that this was so, because the Screwboard, which was the on specifically manual test in the battery, was discarded for other reasons. Presumably th Nailboard functions in part as a manual test, because it consists partly in dropping nai into holes, which is a clearly defined and easily measurable manual operation. The Pe board, for example, a standard test of manual dexterity, requires the subject to do exact this.

VIII. Validities and reliabilities

Table 6

Test	Validity	Reliability
Dice	0·309	0·674
Formboard	0·224	0·600
Block Design	0·219	0·666
Colour Series	0·206	0·773
Cube Construction	0·168	0·435
Screwboard	0·146	0·227
Nailboard	0·142	0·739
General Intelligence battery (Dice and Block Design)	0·329	0·733
Practical Ability battery (Formboard and Nailboard)	0·218	0·689
Combined batteries	0·338	0·799

(All significant at the 0·05 level).

Validities and reliabilities are low (the extremely low reliability of the Screwboard due to difficulties with the apparatus), but not lower than is to be expected from this ty of test and subject. The criterion of success was the company commander's rating f 'intelligent work'. One would expect validities to be somewhat lower than with a pure cognitive criterion, such as an examination. Reliabilities are also a recurrent problem the testing of primitive people. On the whole, the results are much as had been expecte

IX. The selection test batteries

The final task was to draw up selection test batteries for (1) general intelligence, a (2) practical ability.

The Screwboard and Cube Construction tests were discarded because of their extreme low reliabilities. The Colour Series was also dropped, partly because it added little to t validity of an combined battery in which the Dice test was included, and partly becau it was very cumbersome and time-consuming to administer.

Factor analysis suggests that the Formboard (spatial) and the Nailboard (the only te with an appreciable manual loading) should form the Practical Ability battery, and th the remaining two tests, Dice and Block Design, should comprise the General Intelligen battery.

X. The influence of length of army service

Table 7. *Colour Series plus Dice test*

Length of service	No. of men	Average Grade (s.g.)
Less than 1 year	400	3·000
2–3 years	6	2·500
3–4 „	3	3·000
4–5 „	7	2·857
5–6 „	10	3·100
6–7 „	3	3·333
7–8 „	6	3·500
8–9 „	4	3·000

(Grade 3 is higher than Grade 4).

Table 8. *Variance analysis*

	Sum of squares	d.f.	Mean square
Between groups	3·574	7	0·511
Within groups	504·424	431	1·173
Total	508·998	438	—

$F = 0{\cdot}435$ $P > 0{\cdot}10$

Differences not significant.

Table 9

Length of service	No. of men	Average Grade (s.g.)
2–5 years	16	2·750
5–9 years	23	3·217

(Grade 2 is higher than Grade 3)

Difference $= 0{\cdot}467$ $t = 1{\cdot}622$
s.e. of difference $= 0{\cdot}288$ $P > 0{\cdot}10$

Difference not significant.

There are no significant differences in intelligence (as measured by the Dice and Colour Series tests) between Gurkha soldiers with different lengths of service in the Army. The tendency is, however, as with British troops, for the younger men to do better than the older men. This is an important finding, as it was thought that the low test scores gained by recruits might be partly due to unfamiliarity with their new environment and that their test scores might improve with length of Army service.

XI. Tribal differences

Results for the Dice test are available for men of the following tribes:

I. *Mugar:*
(*a*) Thapa. (*b*) Rana. (*c*) Pun.

II. *Others:*
(*a*) Central Valley. (*b*) Rai. (*c*) Gurung.

Popular and literary opinion is that the Central Valley recruits are the most intelligent and that the Pun is the least intelligent.

Table 10. *Dice test*

Tribe	No. of men	Average Grade (S.G.)
Mugar:		
Thapa	112	3·607
Rana	30	3·667
Pun	55	3·730
Others:		
Central Valley	10	3·000
Rai	17	3·290
Gurung	144	3·513

(Grade 3 is higher than Grade 4).

Table 11. *Variance Analysis*

	Sum of squares	d.f.	Mean square
Between tribes	6·868	5	1·374
Within tribes	809·568	362	2·236
Total	816·436	367	—

$F = 0{\cdot}615 \quad P > 0{\cdot}10.$

Differences not significant.

There is no significant difference in ability (as measured by the Dice test) between th different Gurkha tribes. The order of merit, however, agrees closely with popular an literary opinion based on observations of the Gurkha in everyday life. Moreover, th Mugar sub-tribes all score at much the same level. Differences are fairly small. Th average Gurkha placed in a typical Central Valley community of 100 men would ran about 60th. In a typical Pun community he would rank about 40th.

XII. Conclusions

On the whole, the research raised more problems than it solved. Its main value wa perhaps that it verified so completely the findings of other workers in the field, tha conventional tests have a very limited usefulness with primitive peoples, and that researc is required into new methods of testing.

It may be that the best approach is through individual tests of the Binet type. In th case of Gurkhas the experimental difficulties would be considerable. On enlistment r recruit knows his age, for example, and many of them are shaky about their name An individual test would be likely to end up as a series of apparatus tests, little differen from the group tests tried out in the present research.

It might be possible to devise practical outdoor tests, similar to those used in offic selection, but it would not be easy to get reliable estimates of ability from this type test. An intimate study of the Gurkhas' home life, made on the spot by a person speakin their language fluently would seem essential if we are to have a fuller understanding their capacities.

The purpose of the present research, however, was to classify the men according t their suitability for certain Army trades and employments.[1] We were looking for tes at the cognitive level, of the adaptability of the recruits in using unfamiliar equipmen and mechanical devices. The ability to educe relationships and correlates presumab

[1] Biesheuvel considers that 'occupational fitness, as opposed to educability, relates to the individual as he to the kind of job he can do now. Provided, therefore, that adequate tests of effective ability can be designe there is no objection against the direct measurement of the occupational fitness of primitive peoples'.

plays an important part in the performance of all people. It is useful to have found measures which do differentiate between natives in this respect, and which correlate with success at work, whatever reservations have to be made about the absolute level of performance. From the vocational point of view this is the obvious first step, and this research was not designed to go beyond it.

XIII. Summary

1. The general purpose of the research was to devise tests for allocating Gurkha recruits to various Army employments.

2. The performance of the recruits was very considerably below British standards. Less than 2% scored above the British median.

3. Owing to the extremely low educational level of the ordinary Gurkha recruit, the experiment was confined to performance tests.

4. Test reliabilities and validities were low, but not lower than is to be expected for this type of test and subject.

5. Recruits were liable to misunderstand the instructions completely, and to set out upon the wrong task. For this reason it was necessary to make certain that the instructions were understood. Every man had to work examples and have them checked before the test began. The tester was allowed to give explanations in addition to the formal instructions.

6. The most striking thing about the recruits was their general passivity and slowness of movement. They were not curious about being tested. Nevertheless, their attitude was one of amiable co-operation. They were clearly doing their best.

7. The final recommendation was that all recruits be given two batteries of tests: (i) general intelligence (Dice and Block Design), and (ii) practical ability (Formboard and Nailboard).

8. There was no significant difference in test score between men with different lengths of service in the Army.

9. There was no significant difference in test score between the different Gurkha tribes, although the results tended to confirm popular and literary opinion.

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ORIENTATION IN THE MOLE-RAT *CRYPTOMYS*

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I. *Introduction* (pp. 134–135). II. *The mole's method of tunnelling* (pp. 135–137). III. *Examples of orientation when tunnelling is disturbed* (pp. 137–140). IV. *Discussion of the mole's sense organs* (pp. 140–142). V. *Possible explanation of detailed orientation* (pp. 142–143). VI. *Comparison of results with those of other investigators* (pp. 143–144). VII. *Summary* (pp. 144–145). *References* (p. 145).

I. Introduction

After a careful analysis of experiments and observations in connexion with orientation in invertebrates, Rabaud(7) came to the conclusion that all the invertebrates which have a 'nest' and which leave it, utilize sensory cues comparable with one another. According to the species and the conditions, these cues are visual, olfactory, tactile, baraesthetic or kinaesthetic, but all are of a sensory nature.

In some insects, e.g. the bee and the wasp, observations show that orientation is mainly based on sight, whilst in others, e.g. the butterfly, it is mainly based on smell. Kinaesthetic, olfactory and tactile senses or a combination of these certainly play their part. Also, as far as orientation in vertebrates is concerned, there seems to be no need to assume a sense of orientation, *sui generis*. Especially informative in this connexion is a large-scale experiment made in 1895 involving 5000 pigeons. They were released at sea at distances 146, 200, 300 and 500 km. west of Croisic.

> The speed of the return diminished with the distance; it was from 75 to 88 km. an hour for 200 km., 60 for 300 and barely 40 for 500. The altitude of the flight increased with the distance from land; it was sufficiently great, when the liberation was effected at 500 km., for pigeons to be invisible to the naked eye. As for the number of returns, this diminished with the distance. Out of 1500 pigeons released at 500 km. 300 returned at the end of 48 hours; the others were found scattered everywhere, in England, Spain, Portugal, Algeria, at Cape Verde, in Egypt and in the Caucasus. In short, return to the point of departure became a matter of chance.(7)

Rabaud also refers to Thauziès' experiments which show slowness to return from distant points of liberation 'and one conceives rather of birds wandering at hazard and finally encountering some landmark which puts them on the way'. The greater the distance of liberation the less there is a chance of encountering cues, especially those of a visual nature. Buytendyk(3) analyses the problem of migration of birds and assumes an instinctive reaction to physical conditions, e.g. the total physical character of autumn. According to him winds of a different texture, wind direction, the position of the sun, the falling of leaves and the general changes occurring in plants and animals are all stimuli effective in evoking migration to other parts of the earth. As in all instinctive behaviour a drive urges the bird to set off.

The ductless glands also, especially the sex glands, contribute towards adaptation of nature. There are many instances of migratory adaptation to environment of this sort, e.g. the breeding behaviour of the eel. When migration is not possible, other modes of protection are resorted to, e.g. those of lung fish, the *Protopterus*, of tropical Africa which forms a protective cocoon in which it hibernates during the dry season, gradually becoming active again as the water in the rainy season softens the cocoon, which eventually breaks up, releasing the fish in a semi-dormant condition. Similarly, the homeward journey

n birds may be evoked by inner urges adapted to external conditions, viz. returning to est. The main point is that though possible cues may direct the course of flight they all epend on the ordinary sense organs.

Katz(6) gives and interprets cases of homing in dogs, e.g. his interpretation of the bservations of Bastian Schmid and others. He states that similar factors are at work as n the case of swallows but that the motives are different. There are great individual ifferences in the homing ability among dogs. Katz postulates a primitive mechanism of rientation which must be placed very early in the evolutionary scale. 'In us it is blunted rough disuse, in primitive peoples it is much more efficient and with its aid, animals uch as dogs can perform amazing feats.' Katz analyses the act of orientation in man from noment to moment during life. He points out that it can be demonstrated that during all hanges of position we strive to remain continually orientated with regard to our sur- oundings. This takes place almost involuntarily. He shows that valuable information n the 'obstinate striving towards correct orientation is to be found in experiences of udden loss of orientation'.

For the present it is neither advisable nor possible to say any more in explanation of orientation henomena in dogs and men. This will not be possible until new experiments have been carried out with ariations suggested by the new aspects which have emerged here. Why should not experiments be stituted under the same conditions as Schmid's but with human subjects?

The authors mentioned above, though slightly differing in their directions of attack, ave this in common that no one accepts a sense of orientation, *sui generis*. Their view- oints may be considered fairly representative. Bierens de Haan, however, postulates compass-sense(2).

We may refer to Crozier & Hougland's(4) experiments on *Tenebrio* larvae and rats for etermining factors of immediate orientation. These amount to direction of bodily ovement to the right or left, or in a forward direction according to the presence or bsence of obstacles at the side of the body. Such may be considered as innate reactions o certain stimuli. That they should be present in animals differing so widely, is not a little emarkable. Buytendyk(3) stresses this phenomenon of the similarity of instinctive ehaviour in the most diverse species of animals.

It seems as if workers have not, so far, paid much attention to the problem of orientation n animals living underground, e.g. both the rodent as well as the insectivorous moles. here are also lower vertebrates, e.g. blind snakes (*Typhlops*) inhabiting the soil, which ay present interesting problems of this nature. We have therefore been led to consider ne behaviour of the local Orange Free State mole-rat, *Cryptomys Bigalkei* Roberts.

II. The mole's method of tunnelling

he ability of this peculiar animal to orientate itself without the sense of sight, is remark- ble indeed, the more so because of its special mode of life in a narrow underground unnel. Its mounds are clearly worked up in a more or less definite direction. Close nspection shows them to lie roughly in two parallel lines. If lines are drawn through each f the two rows of heaps the main tunnel may be located running parallel between them. he reason is that the heaps are thrown up via side-tunnels leading with varying incline o the surface. These side-tunnels are made to the left and to the right of the main tunnel lternating irregularly. The distances between the heaps may vary very much.

When the main tunnel is opened up, at the most recent mound, it is possible if on works backwards, to open many yards in a short time. The mole in the meantime ha retreated in the direction of its nest. If one stops working and watches the entrance t the tunnel where one ceased opening up, one very soon notices that the mole in a charac teristic manner works out a mound at that spot, precisely as if this part of the tunn now served as a side-tunnel. The main tunnel consequently deviates either to the righ or the left for a short distance, or perhaps only takes a turn or bend. Then the mol continues to bore, following the line of the first opened tunnel. Within limits it will kee parallel to the original tunnel up to the spot where it ended foremost from the nes This new tunnel may now be opened in the same manner and for the same distanc Again the mole will repeat the same behaviour. The mole's third tunnel may then b opened and with the same result. This may be repeated almost indefinitely. In little le than three months, the author, working almost daily, has been able to open up one syste in this way eleven times over.

This manner of opening up the tunnel may be varied. For instance, certain obstacl to be overcome by the mole may be introduced so as to present problems to be solve The mole-rat has its tunnel only a few inches below the surface; what will it do whe a relatively deep transverse furrow of a certain length is dug where the tunnel has to pas What will it do if a big stone is placed in the course of its tunnel? Again, what will it d if, after opening up a section of the tunnel some distance from the nest, one artificial continues the undisturbed section in a new direction (e.g. by means of a canvas pi dipped in mud and dusted with loose soil inside, which is turned away at a given ang from the original direction of the tunnel boring)? How will the mole behave if any portio of the remaining tunnel between the most recent heaps and the nest is opened u Lastly, what will the mole do if it is cut off from its nest, which may be done b starting to dig at the nest end of the tunnel and gradually working several metres awa from it?

The answer to all these questions is that the mole will not only overcome these obstacl in a characteristic manner and eventually arrive either at the remote end of the tunn originally opened up or at the spot nearest its nest, but it will do so even after son months of hard labour and continual hindrance. The following observations will expla what is implied above.

It is clear that in its natural state the mole may encounter an obstacle such as a ha ant-hill, a stone or even a very hard and dry portion of the field, or a very sandy porti where the roof of the tunnel and walls continually collapse. In all these cases the mo will in the great majority of cases deviate to a great extent, perhaps tunnelling in a cir but eventually following the original direction again, very close to that of the first tunn Sometimes earth only an inch thick will separate the new tunnel from the previous tunn of which usually only the roof is disturbed, whilst the walls and floor are left inta Sometimes up to as much as almost 5 ft. of the original intact tunnel is plugged towar the nest with soil and a deviation is made from there. However, the mole soon tur inwards again towards the former tunnel-route and then keeps parallel to it.

There are individual differences. Some moles when hindered (e.g. by opening up rece tunnels) will keep as close as possible to the original route, resorting more and more burrowing under tunnels previously opened up. Others do not bore quite so near to t recent tunnel and therefore do not need to burrow under existing tunnels. Also some pl

e tunnel-ends nearest the nest more often than others do and for longer distances. me deviate to the right only, some to the left only and others to either side.

III. Examples of orientation when tunnelling is disturbed

System A illustrates a case where the mole-rat was disturbed at the remote portion of tunnel.

System B where it was disturbed between nest and veldt.

System C where the animal was cut off from its nest which was opened up, as also its nnel for some distance from the nest.

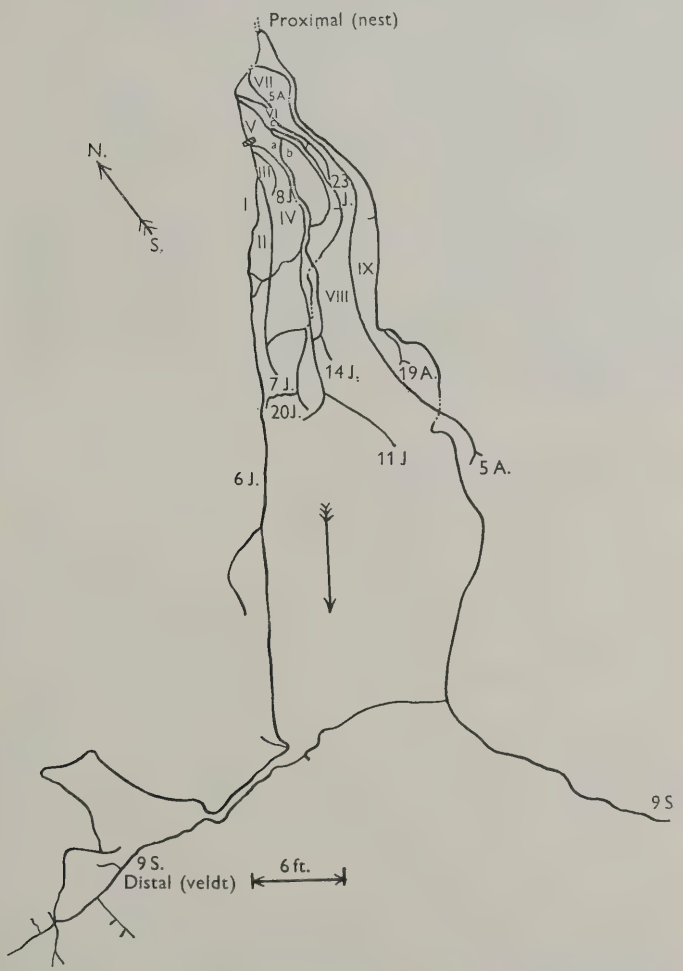

Fig. 1. System A. I–IX = 1st–9th tunnel; 6 J.–9 S. = 6 July 1949–9th September 1949.

System A

From the map it will be seen that on 6 July 1949 from the newest heaps the tunnel was pened up for about 50 ft. (See extreme south-west portion of tunnel 1 of System A.))n 7 July the rat had tunnelled about 15 ft. parallel to that opened on the 6 July. The ame day this last tunnel was opened. On the 8th it started another tunnel which after

forming an arc of a circle, again took the direction of the previous tunnel. So the expe ment continued. When the eighth tunnel was bored and opened on 5 August the to distance (gauge) between the first and last channel was approximately 12–15 ft. It w decided that the animal be left to bore indefinitely and observe its course. Again it ke approximately parallel to its last tunnel but crossed this by boring for a short distan under it when it reached the length of about 27 ft. It then continued parallel to the fi tunnel opened on 6 July and now separated from it by roughly 15 ft. When it reach a point about 46 ft. from the beginning of this last tunnel the animal deviated to its l and kept this direction for about 16 ft. But it then turned back in the same tunnel a started boring at right angles, reaching the nearest possible point of the original tun on about 8 September, two months since the first opening of the channel! The point fr which it bored at right angles towards the old tunnel is indeed the only correct poi from which to tunnel, because just where it reaches the first tunnel this latter turns aw again, with the same angle as that by which the last tunnel deviates towards the sou west. This leaves an island obstacle of about 250 sq. ft.

Again this tunnel was opened up on 9 September. Ten days later a new tunnel w finished parallel to the one opened on the 9 September. But this time the mole's deviati to its left, i.e. the mistake, only continued two-thirds of the way parallel to the previo deviation. Otherwise it followed the original tunnel very closely. It reached its termin on 19 September having taken only 10 days to cover a distance of 60 ft. compared wi a previously noted time of 34 days.

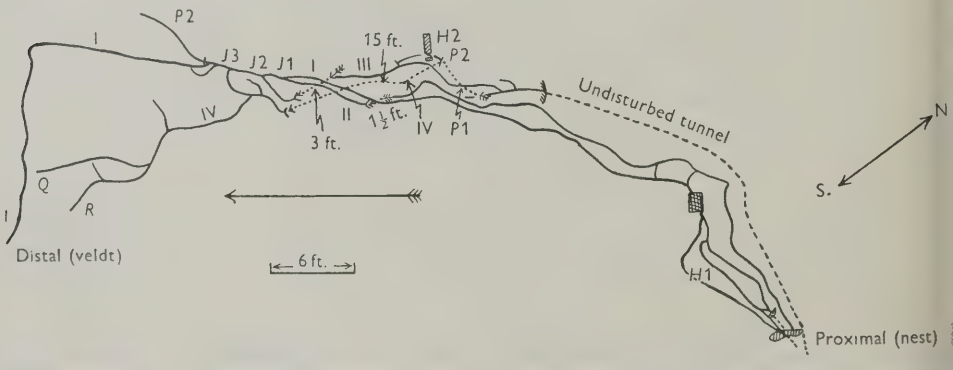

Fig. 2. System B. I–IV = 1st–4th tunnels. *P* = soil-plugged portions. *J*1–*J*3 = Junctions. *H* = hindran

System B

System B was made use of to study the mole's behaviour when it fled nestward and tunnel was opened up for a few yards between the nest and the terminus in the vel The nest-veldt relation was roughly north-east to south-east. Observations made o a few months showed that here also every recent tunnel was bored parallel to the recently opened up. But they soon joined the undisturbed veldt portion of the tun sometimes with an acute angle sometimes at right angles, a foot or so farther than nestward opening of the veldt portion of the tunnel. See System B, landmarks *J*1 and

Here also all kinds of obstacles were overcome by the mole. But in this case this pa cular mole clearly showed a tendency to keep very close to previous routes. It effe this by boring every time for longer distances underneath previously bored tunnels wh

d been disturbed. But again it worked roughly parallel to these. 'Dip'-tunnelling thus creased from $1\frac{1}{2}$ ft. in length to 3 ft. and eventually to 15 ft.! Compare tunnels I, II, I, and IV of System B, the dotted portions representing 'dip' tunnels.

In one case a deep transverse furrow was dug across the expected course of tunnelling t a narrow ridge across the furrow was left intact. The mole bored directly underneath is narrow ridge in order to be able to continue its direction. See System B, landmark *H* 2.

A very natural obstacle encountered by the mole was a fairly large *Buphane* bulb. om a point 1 ft. south-westward it started a new tunnel, first for some distance keeping uth-westward, then bending westward and eventually it joined the intact tunnel, at ndmark *J* 3.

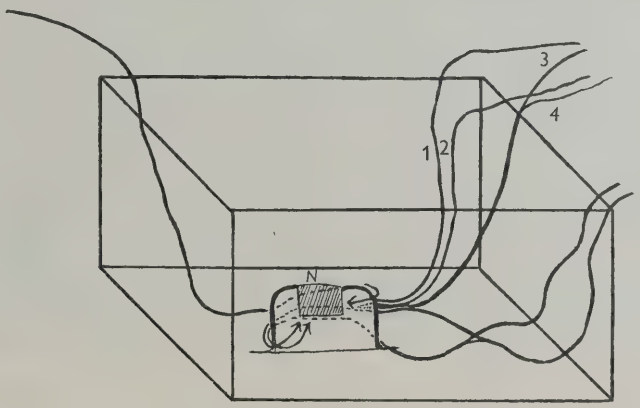

Fig. 3.

System C

System C refers to the opening up of a nest (without young or stored food) probably nmon to several moles because of the fact that

(i) several tunnels radiate from it in all directions;

(ii) no other nests have been encountered although fairly extensive excavation was made;

(iii) the size of the nest ($5 \times 7 \times 8$ in.) was several times the size of a nest formed by a single mole in captivity during winter.

The different tunnels led from the veldt to a little elevated locality. In the opening of e tunnels care was taken to keep at least a considerable portion of the tunnel intact, cluding naturally, the floor and at least half the height of the walls. Where one tunnel s below another the lower portion was left untouched and indicated by pushing reshly cut stick through it. Usually the tunnel is only a few inches below the surface the earth, but at this particular spot where the nest was found the tunnels slanted wnwards forming an irregular spiral in so doing. The decline might be as much as in. to 2 ft.

In this system the animal was cut off from its nest. We had scarcely finished digging when e approach of the mole was deduced from the mounds which were being thrown up one er the other and precisely parallel to a tunnel opened up by us in the manner described. was very interesting, indeed, to observe how the animal continued parallel with this nnel until it eventually reached the nest. The next day this tunnel was opened by us

in the same manner and it was found that the nest was enlarged at the one side, probably because the roof of the nest was removed although we covered it by means of paper and soil. Thereafter the animal again approached the nest by tunnelling parallel to the position of the previous tunnel and using portions which we left intact.

Therefore, no matter whether the tunnel was disturbed at the far end, at the nest end or in between veldt and nest, the mole always showed a remarkable urge and ability to orientate itself. If disturbed in the veldt the mole ran back, but then there was such a strong urge to tunnel in the original forward direction that disturbing its work a dozen times during two months and involving roughly 200 ft. of repeated tunnelling would not prevent it pursuing that direction. Eventually, even after two months it reached its original veldt-locality! Several other investigations of this type corroborated this observation.

It is clear that the mole's urge to reach its nest for protection should be strong. Especially when it is disturbed it seeks protection nestward or in its nest. Similarly the drive veldtwards in search of food is strong. The problem of orientation is, however, forced on one's attention. An explanation must be found based on existing sense organs and on instinctive adaptation to the environment.

IV. Discussion of the mole's sense organs

Let us then consider the animal's sense organs. In the laboratory we have subjected *Cryptomys* to different experiments concerning its sense of sight. Its eyes, which are the size of a pin-head, are kept open except when it sleeps. If a sudden strong concentrated light is flashed on the eye when in the dark there is no winking. The animal is, however, very sensitive to air currents. By making use of the latter as an unconditioned stimulus we tried to condition the animal to respond to a flash of light, but without success. Also when one watches the animal moving about in captivity, one notices that neither in daylight nor twilight does it react to visual stimuli. This is to be expected, for there is total darkness in its tunnels, and it does not normally leave these tunnels for surface wanderings. It does come to the surface when sick or when the sand is too loose to make tunnelling possible, or in captivity, when all the *Homeria* bulbs on which it is fed have been eaten. However, this does not exclude the possibility of sensing a difference between light and darkness. The following observation seemed to indicate such a possibility but another explanation may also be offered.

From a fairly fresh mole heap the loose soil was briskly removed leaving the clear circular opening of the side-tunnel. A glass plate was immediately placed over it and its edges plastered tightly to the surface by means of moist earth so that no air could penetrate. At each corner small stones were placed. The sunlight was the only possible remaining external stimulus. Nevertheless the animal plugged this end of the side-canal thereby excluding the light. It might also, however, have reacted to the air current no matter how brief its inflow was. However, in the glass case in the laboratory the moles very often bore right along the floor or against the sides of the case, with light penetrating and illuminating the tunnel. (See Pl. 1, fig. 4.)

As far as its sense of smell is concerned our observations do not indicate a very much higher development than sight. For instance while working out loosened soil in the veldt it does not react to the presence of a person coming very close to its body. Also behaviour during courtship shows that smell is of minor importance. The animals very often r

Fig. 4. *Cryptomys* in tunnel of glass cage. Leaves of *Homeria* bulbs are visible in the soil.

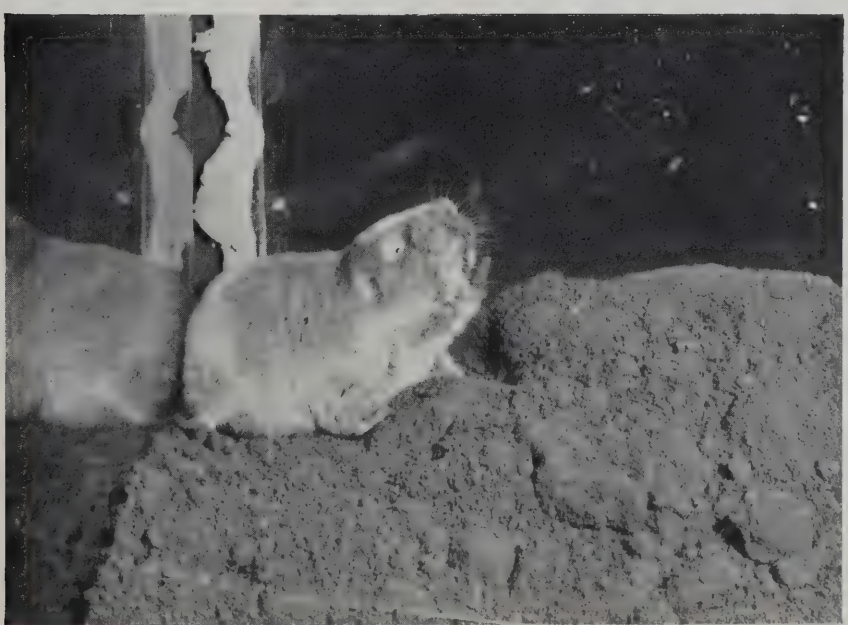

Fig. 5. *Cryptomys Bigalkei* (Roberts). The mole-rat in charging attitude as a result of a current of air blown on it.

nst each other, whereupon the fierce female immediately charges, the male producing eaky 'pleading' noises which cause the female to behave quite differently, e.g. walking ront of the male lifting up one hindleg. However, the mole's nose is then kept near female's external sex organ in the characteristic male animal fashion. Much more nsive work must be done in this connexion. But our experience is that the sense of ll, although it may be used, is not highly developed.

he mole's sense of hearing, on the other hand, is well developed. But, there is a total egard of distant noises no matter how intense. Harvard planes, human chattering, ol engines of tractors nearby, all leave the mole unmoved, just as if it had become l to them. But a teeth-grinding noise nearby, a squeaky noise, and vibrations (e.g. se caused by walking) provoke a distinct reaction. There is total indifference to the ton whistle. But a blow on the table by means of a closed penknife, or similar object, ses a typical fright reaction in the animal, who may, for example, hurriedly retreat kwards. It reacts only to nearby auditory stimuli, which signifies probably, a sensitivity y to stimuli of direct biological meaning to the mole.

'he mole's sense of touch is very delicately adapted to its mode of eating. With closed s it will get hold of a *Homeria* bulb, e.g. one with the leaves still on, and first of all it nip off these leaves. Thereupon it will peel off the basket-like covering of the bulb il only the solid bulb is exposed. This it now grasps by means of its fore-claws and bles at it as a squirrel would. *Cryptomys Bigalkei* lives almost exclusively on *Homeria* bs, and its distribution follows that of *Homerias* very closely. The moles in the labora- y were fed exclusively on *Homerias*, one of them for almost two years.

t is possible that the sense of touch, and the kinaesthetic sense together play an portant part in connexion with the animal's easy movements in the tunnels. This may easily seen in a large all-glass cage containing moist soil, at least 9 in. deep. In such age the moles always bore down to the glass bottom; thereby their doings may be tched from underneath or with the aid of a mirror and illumination from below. Their sticity of movement is especially clear when a side-tunnel is formed and the soil from front end of the tunnel is worked backwards and outwards via the side-tunnel. The d from the main to the side-tunnel is followed backward with great precision, some- es with no visible touching of the walls.

f a young mole starts boring away from its nest, in the first instance it is probably rching for food; secondly it may be starting a new system, eventually having its own t. *Homerias* are found almost everywhere in the Bloemfontein district, but in some ions they are more prevalent than in others (owing to variations in moisture, type of , and methods of distribution, e.g. by means of the direction of flow of water and wind). e animal certainly stops boring during dry seasons, which contrasts with its great ivity in wet seasons. It also cannot bore in hard soil. Where the surface seems to icate hard soil, e.g. under tennis courts, old roads, etc. further investigation shows t where moles have tunnelled the soil has in fact been moist and soft. It must be nembered that its fingers and toes are in no way adapted to digging, which is effected ly by its lower incisors. Only loose soil can be worked backwards by means of its nds and feet.

t has been observed that in a given homogeneous area mole-tunnels may be found ning in different directions and even crossing one another, but never on the same el, i.e. they cross by 'dip'-tunnelling. The problem of orientation concerns not the

general direction of the tunnels (i.e. to where food is relatively easily obtainable) b the individual directions followed and maintained even after endless disturbances a the presence of obstacles. These require more detailed orientation than is involved maintaining the general direction. What are these cues which enable the mole stubborn to maintain the direction it has once followed nestward or veldtward?

V. Possible explanation of detailed orientation

The explanation seems to be in the animal's sensitivity to air currents and its sense hearing.

To no stimulus is the mole so sensitive as to a current of air. A sudden small curre of air ejected on to it by means of a rubber ball and glass or metal pipe and direct anywhere on to the animal's body evokes a violent total reaction. The mole immediate takes up a charging position, throwing the head backwards or sideways and showing i two large lower incisors, each of which may move separately from the other because of t fact that the mandibular symphysis is not ossified. It very often utters a low grunt. O hardly ever sees this animal in a more aggressive attitude than this evoked by a sudd air current. (See Pl. 1, fig. 5). It is likely therefore that here is a reaction which plays important part in the animal's life and habitat. As soon as an enemy, e.g. a dog, tries open a side-tunnel a current of air is sensed and the mole will charge, very often biti the dog's muzzle.

If a side-tunnel of a mole's habitat is opened by quickly scraping the loose earth the heap, the animal closes it up again. The author has tried this many times. In cas where no such closing took place it was due to the fact that part of the tunnel was longer in use, having perhaps been trampled on by horses or cattle.

These side-tunnels, as already noted, differ from the main tunnel in the fact that th typical construction is upwards to the surface. The hindquarters of the mole may oft be seen, especially when the heap is still in its initial stage. This means that the anima first contact with the air is made with its head when it bores the side-tunnel until it just through the surface. Thereafter its hindquarters come into contact with the air it pushes the soil outwards. In this manner regular contact is made with the surface The following tentative explanation of how the mole orientates itself may be put forwa and is in line with Buytendyk's approach. In the first instance we assume biologi adaptation of the mole to its mode of life. There is no group life—only solitary existen These tunnels do not allow a number of moles to be together boring for food. Be a solitary animal the mole is consequently very aggressive by nature, and outside tunnels there is random movement but no real fleeing. This aggressiveness has been no by other observers as a marked characteristic of all blind moles(1,9,10).

At any given time of the year the wind directions are fairly constant. The differ winds may be physically different according to the contents of the air from certain regi (desert, sea, cold, heat, etc.) But there may also be minor local differences, e.g. wh a certain type of shrub grows year after year, where there are trees, and other fact e.g. stones of varying size, causing changes in air pressure and movement.

If we keep in mind the animal's very great sensitivity to air currents, it seems poss that the animal uses the heaps, or the side-tunnels leading to the surface as gauges of surface air condition, and especially of the permanent conditions. These provide his for orientation from moment to moment in the manner described by Katz for anir

l man (6). The mole may also use all his other available senses especially the kinaesthetic, ell and hearing. Its orientation in space is probably enhanced by repetition. When owing out loose soil the mole may travel the same path a dozen times or more. To reach ecent heap remote from the nest it has, indeed, to pass every foot of the older tunnel, ich thereby becomes so thoroughly familiar that it is eventually run with almost chanical precision. It must also be noted that these animals keep to a certain locality many generations. The late Dr Austin Roberts (8) has observed one habitat near toria being used for over 18 years. Thus, just as a blind man staying at a certain place entates himself with the aid of senses other than sight, so also does the mole in order be able to keep his direction, if the tunnel be disturbed (as very often happens owing natural causes) be it at the nest end, the veldt end, or between veldt and nest.

Though the mole seems to be rather indifferent to sound or noise, yet it is quite possible t fixed sources of sounds or noise may also provide cues. In the case of the mole tems referred to in these paragraphs, there were in fact certain fixed sources of sound. out 300–400 yards south-west of the field was a native compound; north-west was airly active airport, about half a mile away; the Grey College was situated 300–400 ds north. But the most constant source of noise was the city proper, eastward of the d. The station and goods shed, the power station, and other industrial plants, fixed rces of sound, are present in this eastern quarter of the town.

It should also be noted that winds, especially the north-westerly wind, are relatively stant in this area, as may be inferred also from the fact that most trees lean over to south-east. These winds blow against the tops of trees, or against electric or telephone es and posts, or even against smaller objects. These objects, if permanent or relatively manent, may possibly, provide auditory cues.

VI. Comparison of results with those of other investigators

lman (11), when discussing the problem of spatial orientation in rats, refers to Dashiel's periments illustrating the rat's propensity, after learning, to select certain types of atially directed or arranged patterns more readily than others. Dashiel (5) used a maze ering a great number of alternative and equal-length pathways from the entrance to exit at the food-box. There were twenty equally correct but different pathways. The ults were as follows:

> Each animal learned soon to adjust to the situation not by fixating some particular pathway but by ning in the general direction of the exit now by one succession of turns and now by another, so that series of trials it followed a variety of different courses from entrance to exit. Each course was followed hout error and each without any previous practice therein. An animal's ability to do this indicates that animal was possessed 'of some more general orientation function'. This general function enabled it to sue new pathways while remaining successfully oriented toward the objective.

Results obtained by E. C. Tolman and C. H. Honzig (12, 13) from experiments using mazes indicate that food-pointing blinds are entered more frequently than non-food-inting blinds; all groups built up an expectation as to the general direction of the it-box and this expectation was usually more active if a group were hungry and if it re rewarded.

This directedness towards the goal is also apparent in Yoshioka's experiments (14) with o equally long alternative routes one of which points back towards the goal sooner than

the other. His rats were offered a choice between a circumscribed triangle and an inscrib pentagon of the same length. There was a significantly larger percentage of choices of t inscribed pentagon than of the circumscribed triangle.

Tolman (11) explains this result as being 'due to the fact that the pentagon turns ba toward the goal sooner than the triangle'. It is assumed, in short, that the rats soon ca to anticipate the general direction of the goal, and that, given this expectation of t goal's direction, the pentagon seemed to them to offer a more direct route to the goal th did the triangle.

These data suggest that a general directedness is obtained by the rat independently visual and olfactory cues. A remaining factor is probably recollection of the directio based on kinaesthetic sense. This implies good retention of every bodily turn, witho which the animal would soon be out of the general direction. No matter what deviatio are made from the goal, for the rat's forward direction at least is kept correctly.

In these experiments auditory cues may also have been available to the rats. Certa sounds and noises might have come from certain fixed localities, such as those enumerat above, e.g. a factory, a station, an airport, schools, wind through tree-tops, struts electric wires on poles. Only by eliminating the possibility of such auditory cues cou one be justified in inferring the existence of a sense of general direction, *sui generis*.

After blindfolding myself in my laboratory I walked forward, turned round, turned different directions, walking irregularly and constantly changing my direction. Yet I cou easily determine my compass bearings. After a little consideration it soon became cle that it was mainly auditory cues on which I based my orientation. The natives we working outside on a spot north-west of the laboratory, whilst inside the building t students usually assembled and talked loudly south-east of the laboratory. Blind perso rely to a large extent on such auditory cues.

If Tolman, Dashiel or Yoshioka's researches yielded the same result when the expe ments were conducted in a soundproof room or when the maze was every time chang through the points of the compass, then auditory cues might be considered irrelevant.

We must, of course, not commit the anthropomorphic mistake of crediting anim only with those senses human beings possess. In the case of fish and some amphibia e.g. *Xenopus*, a lateral line sensory organ is present, adapting the animal to certain aspe of its aquatic mode of living. Also it must not be forgotten that the senses as we kn them in man may be so remarkably sensitive or specialized in animals, in keeping w their mode of living, and differing quantitatively so much from our senses, that they hardly recognized as being essentially the same as ours. The bird's eye must in some w or other compensate for its lack of forward vision, and the consequent stereoscopic vis by which man accurately gauges short distances. If a hawk from a high altitude di down on its prey its perception of distance must be considerable. Probably kinaesthe sense of head and neck and ability to detect 'local signs' may be keenly developed.

All this being granted it still means that spatial orientation is determined in the long by sensory cues.

VII. Summary

The mole-rat *Cryptomys* of the Orange Free State is blind and lives in tunnels a few inc under the surface of the earth. It feeds on the small yellow tulip, *Homeria*, whic prevalent in this Province.

The distribution of the mole is determined to a great extent by the distribution of *meria* species. But apart from this fact, the mole-rat shows a remarkable ability to low a direction or find a spot where it previously bored a tunnel. If this tunnel be stroyed from its veldtward terminals backward, while the mole flees towards its nest, will bore another tunnel parallel to the previous one, overcoming difficult obstacles, ich sometimes necessitate great deviations. The mole may thus be disturbed a dozen nes, but even after several weeks it will again find the spot where it bored before it was sturbed. If it is cut off from its nest in the veldt-end of a tunnel part of the tunnel to the st is opened up, it will bore nestward parallel to the old tunnel, eventually finding the ot where the nest was. Its ability to do this is explained on the basis of sensitivity to currents and to sound. By means of its many side-tunnels with the heaps on either side the main tunnel, the mole makes contact by means of its mouth or its hindquarters th the surface air, and senses changes in air currents; it may also perceive noises from ed sources, e.g. wind through tree-tops, telephone wires, industrial plants, airports, etc. veral generations of moles may inhabit the same tunnel area, so that an individual mole ay inhabit such an area for a lifetime, gradually acquiring surface knowledge of fixed urces of air currents and noises. This, it is suggested, eventually establishes its capacity orientate itself.

I wish to express my sincere gratitude to the South African Council for Scientific and dustrial Research for an assistantship and for grants awarded in order to continue search in connexion with the biology of moles.

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THE EFFECT OF INFANT FOOD-DEPRIVATION UPON ADULT HOARDING IN THE WHITE RAT[1]

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I. *Introduction* (pp. 146–147). II. *The experiment* (pp. 147–149). III. *Results of the experiment* (pp. 149–152). IV. *Conclusions* (pp. 152–153). V. *Summary* (pp. 153–154). *References* (p. 154).

I. Introduction

This paper describes a repetition of the experiments designed by Hunt (2, 3) to determine the effect of infant feeding-frustration upon hoarding behaviour in the adult white rat. Our results confirm the original findings (2), and provide additional data on the phenomenon and its nature.

Hunt (2) set out to devise a controlled experimental situation to verify directly the hypothesis, originally propounded by the psychoanalysts and cultural anthropologists, that infant experience can endure and affect adult behaviour. Using rats as subjects, on account of their short life span, he found that animals submitted to a period of feeding frustration after weaning hoarded significantly more pellets of food in adult life than their fully fed litter-mate controls.

There were two parts to the original experiment. In the first part two litters comprising fourteen animals were weaned at 21 days and split into experimental and control groups of seven animals each. At 24 days the experimental group was submitted to feeding frustration consisting of group feedings of wet mash at irregular intervals varying from 9 to 36 hr. over a period of 15 days. The control group had unlimited access to wet mash during this period. Thereafter the two groups were treated alike. Five months after the infant feeding-frustration both groups had equal mean weights, and only hoarded very few pellets of food when satiated. Both groups were then submitted to adult feeding frustration consisting of a 2-day period on a subsistence diet and then 30 min. feeding of wet mash at 24 hr. intervals for 3 successive days: $23\frac{1}{2}$ hr. after the last feeding they were tested in the hoarding alleys. Three more tests were made on successive days, the animals being allowed to retain the pellets they had hoarded. It was shown that neither sex nor litter contributed to the variance of the number of pellets hoarded but that the experiment did so, a *t*-test showing that the difference between the mean number of pellets hoarded by the controls (14) and the mean number hoarded by the experimentals (37·7) would have been obtained by chance in only one out of fifty trials.

In the second part of the experiment two litters weaned on the 28th day were again split into two groups of seven each. The experimental group was submitted to the same infant feeding-frustration procedure as was used in the first experiment, beginning, however, on the 32nd day. From this point on, the experiment was identical with part one. The mean difference in the number of pellets hoarded by the two groups after a period of adult frustration was statistically insignificant.

[1] This investigation was aided by a grant from the South African Council for Social Research.

Hunt(2) concluded that infant experience does affect adult behaviour, but that the ensity of the effect depends upon the age at which the infant experience occurs.

This original experiment has been repeated three times(3), each repetition giving results a lower degree of statistical significance than those obtained in the original. The pro-lure adopted in the repetitions differed from that of the original in several respects. rger groups were used, weaning occurred at 20-days and infant feeding-frustration gan on this day. The infant frustration differed in that the experimental animals were owed several hours continuous access to wet mash on the 1st day, the time being reased daily until by the 11th day the length of the feeding period was reduced to 5 n. The experimental group was without food for two periods of 36 hr. and for six periods 24 hr. Adult feeding-frustration prior to the hoarding tests consisted of 3 days on 30 n. feedings of wet mash. The hoarding trials were executed at various ages and con-quently the weight differences between the two groups had not been eliminated in two of repetitions, the experimental groups being lighter than the control. The findings embled those in the first part of the original experiment, but the differences between the o groups were of a lower degree of statistical significance. Hunt(3) estimated the pro-bility of the collective results of the original experiment and its repetition being due to ance to be 0·00108, and took this as evidence of the correctness of his original con-sions(2).

There was slight evidence in the repetitions that animals from different litters reacted ferently to the infant feeding-frustration, and also, that the experimental animals ate re than the controls after adult feeding frustration.

In the above description of the three repetitions of the experiment we have quoted the ults based on raw hoarding scores. Hunt(3) also used logarithmic hoarding scores in his culations but, as these do not materially affect the conclusions and as the results of this periment are expressed in raw scores, we have not quoted the logarithmic data.

The uncertain nature of the findings of Hunt(2, 3) led us to repeat the experiment. We o wished to determine whether there were any behavioural differences between the perimental and control groups besides the more specific hoarding difference, and, if h differences were observed, whether they were permanent.

II. THE EXPERIMENT

The sample. The animals used were white rats of an inbred strain supplied to us by the iversity of the Witwatersrand. There were, at the beginning of the experiment, twenty-e rats belonging to four litters born on the same day. The litters were split at random o experimental and control groups. One animal was lost from the experimental group ring infant food-deprivation and one of the controls died in the course of the experiment. nally there were fourteen animals in the control group divided into an equal number males and females, and thirteen in the experimental group of which six were males and ven females.

Procedure. On weaning at 21 days the animals of both groups were individually caged d were freely fed wet mash. Infant food-deprivation began at 24 days, as in the original periment of Hunt(2), and consisted of irregular feedings of wet mash for 12 days. We did attempt to keep each animal on an identical feeding schedule as we believed that the stration value of a given degree of deprivation would vary from animal to animal. stead we attempted to keep the weight curves of all animals in the experimental group

parallel during the period of deprivation, a procedure which ensured that the animals wer subjected to more or less identical and measurable treatments. We avoided the techniqu used by Hunt(2) of giving irregular group feedings as this involves so many un-isolabl variables, such as individual differences in eating rate, varying food preferences an inability to eat due to inanition. Prior to ending the period of deprivation the exper mental group was fasted for 36 hr. If any experimental animal showed signs of marke inanition during deprivation it was fed warm milk and cod-liver oil until it recovered. Th control group had free access to wet mash during the time the experimental group wa being deprived.

The percentage loss of weight[1] of the experimental group was the same as that obtaine by Hunt in his original experiment but considerably less than was found in the repetition (Table 1). In this respect, as well as in the age at which frustration began, our experimer resembles the original experiment more nearly than the repetitions.

Table 1. *The percentage weight loss of the experimental group as compared with the controls for all repetitions of the experiment*

This experiment	Original experiment(2)	First repetition(3)	Second repetition(3)	Third repetition(3)
29%	29%	49%	49%	61%

At the end of infant deprivation the two groups were mixed and caged in colony cag according to sex where they remained until 108 days, and from this time until the end the experiment they were reared in isolation. The food pellets (mean weight 5 g.) whic were later to be used for hoarding were fed to both groups from the end of the period deprivation.

The hoarding trials were undertaken by both groups after a period of absolute depriv tion lasting 6 days. This procedure, which does not attempt to differentiate betwe frustration and deprivation, is somewhat more severe than the one adopted by Hunt(2,3 One half hour before the first trial of each run every animal was given a half-pellet of foo We did this because Hunt(2) had observed that some hoarding time in the early part the hoarding trials was wasted in eating. We assumed that the preliminary feeding wou eliminate this uncontrolled variable, and would provide the optimal conditions of depriv tion followed by partial satiation stated by Marx(7) to be essential for maximum hoardi motivation.

In all, the animals were given three hoarding runs commencing on the 119th day, t 174th day and the 196th day. Each run consisted of one 20 min. trial in the hoardi apparatus at successive 24 hr. intervals. The trials were given in a hoarding apparat identical to that designed by Hunt(2), but were carried out in the dark and at a consta environmental temperature ($67 \pm 3°$ F.), the latter condition being observed in order eliminate the known effect of temperature on hoarding(5). All trials took place betwe 11.00 and 15.00 hr. Prior to the period of frustration before the first and last runs t animals were given a trial in a condition of satiation. This was omitted in the second r as it was desired to give the animals as little practice in hoarding as possible outside th obtained in the post-deprivation trials. As the hoarding difference between the two grou

[1] Calculated by the formula of Hunt(3)
Percentage weight loss—

$$\frac{100\ (\text{mean weight of controls} - \text{mean weight of experimentals})}{\text{mean weight of controls}}.$$

l disappeared by the end of the second run a satiation trial was given prior to the rd run to determine what had happened to satiation hoarding in the interval. Table 2 summarizes the hoarding procedure.

Table 2. *Summary of hoarding procedure*

Run	Satiation trials	Post-deprivation	
		No. of trials given	Day of first trial
a	1	3	119
b		6	174
c	1	4	196

At the time of the first run the percentage difference between the mean weights of the perimental and control groups was 2·8%, the experimental group being the lighter. is difference remained until the conclusion of the experiment.

III. RESULTS OF THE EXPERIMENT

Qualitative

e two groups differed markedly after the period of infant deprivation. The experimental mals were all very timid, withdrawing from the experimenter's hand and starting at loud noise. They were continually active and the shaking of a bunch of keys near their e would stimulate them into violent running activity. They also appeared to fight a at deal. The control animals demonstrated none of these symptoms; they lay asleep st of the day, were only disturbed by very loud noises like hand clapping, and they ght out the hand of the experimenter when he put it into their cage. These differences ame daily less marked and had disappeared by the 56th day.

There were, however, permanent differences of behaviour which were evident during the ult deprivation. Again, the experimental animals were more active and more easily mulated into activity by noise than the controls. It was not possible to determine ether they fought more as they were individually caged at this time, but they did show nore marked tendency than the controls to attack the experimenter's hand. These ferences were present in all three periods of adult deprivation and thus persisted when ferences in hoarding were lost.

On all the hoarding trials any loud noise caused the experimental animals to cease arding and to begin agitated exploration of the apparatus.[1]

Quantitative

Table 3 displays the results for all runs. It will be seen that on the first run the ratio of e mean number of pellets hoarded by the control and experimental groups is 1 : 2·2. An alysis of variance[2] (Table 4) carried out on the data from this first run shows that the riance due to the experimental treatment (infant deprivation) exceeds the contribution the other factors included in the table and gives an F value 6·69, a value which would exceeded by chance in only one instance out of fifty. We are, therefore, justified in

[1] All these behaviour changes in the experimental group gave the impression of being 'anxious'. We have rained from mentioning this in the text in case it should be merely an artefact of our own bias.

[2] A preliminary test showed that there was no sex difference. As the numbers in the litter sub-groups were equal it was necessary to weight our data in accordance with the method of Snedecor(8).

assuming that the effect is most probably due to the experimental treatment and not t accidents of random sampling.

This result, taken together with Hunt's (2, 3) findings, confirms the enduring effect o infant food deprivation, for if we combine the individual probabilities of all four experiment being due to chance we find that the collective results would be accounted for by accident of random sampling in less than one instance in a hundred (Table 5).[1]

Table 3. *The mean number of pellets hoarded on each hoarding trial*

	Satiation hoarding	Post-deprivation hoarding trials						Mean no. of pellets hoarded by each rat per trial
		1	2	3	4	5	6	
Run A:								
Experimental	0·6	10·1	5·3	1·4	—	—	—	5·6
Control	0·4	5·2	0·9	1·3	—	—	—	2·5
Run B:								
Experimental	—	23·3	17·5	7·3	4·3	1·1	5·4	9·81
Control	—	23·8	17·8	5·1	2·4	4·0	5·2	9·72
Run C:								
Experimental	2·2	21·6	42·8	19·1	3·2	—	—	21·67
Control	1·1	20·0	36·6	10·1	3·5	—	—	16·55

Table 4. *Analysis of variance carried out on the data from the first run*

	Sum of squares	D.F.	Variance	*F*	*P*
Experiment	7·239	1	7·239	6·69	0·02 (approx.
Litter	3·404	3	1·135	1·05	0·05
$E \times L$	3·976	3	1·325	1·22	0·05
Error	20·556	19	1·082	—	—

Table 5. *The probability of the collective results of the various experiments being due to random sampling*

Experiment	Probabilities combined by multiplication *P*	Probabilities combined by treating each as χ^2 value		
		χ^2	D.F.	*P*
Hunt(3)	0·00108	18·36	8	0·02—0·01
Hunt(3) and this experiment	—	24·56	10	0·01

On the second and third runs a difference between the two groups is maintained, but i both instances it is statistically insignificant ($P < 0{\cdot}05$). Both groups hoarded more o the pre-deprivation trial in the third run than they did on the corresponding trial in th first run and the experimentals again hoarded more than the control, but this latt difference can be attributed to random sampling.

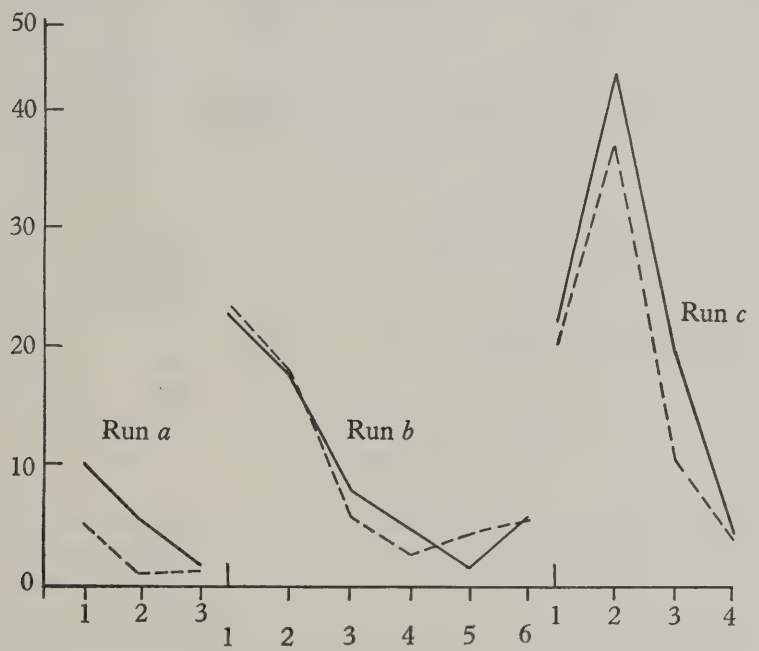
Not only does the difference in the mean amounts hoarded disappear in the course of th experiment, but other changes occur in hoarding behaviour from run to run. These a best seen when the results are expressed graphically (Fig. 1). The maximum amount hoard

[1] Hunt(3) noting that the experimental group hoarded more than the controls in all his experiments but th the probability of such a difference being due to random sampling was high in each of the replications, f justified in combining the probabilities of the four experiments to obtain an estimate of the probability of t collective results being due to chance. He simply multiplied the independent probabilities to get this combin probability. The author felt that the uncertain nature of the results demanded a more conservative estima They therefore used the method described by Lindquist(4) in which the individual probabilities are treated χ-squared values. It will be seen (Table 3) that this method gives a higher value of *P*, but one which make unlikely that the findings are due to random sampling.

creases from run to run, and hoarding diminishes more rapidly from one trial to the ext in the later runs.

Hunt (3) believed he had found a litter effect in his experiments. The analysis of variance 'able 4) carried out on the data from the first run gives little evidence for such an effect the F values obtained for litter by experiment interaction might have been obtained accidents of random sampling in as much as one instance out of twenty.

As the experimental group demonstrated symptoms of a kind which would imply a ecreased tolerance to disturbing stimuli we decided to test all animals for frustration lerance. Maier (6) has shown that rats experiencing severe frustration are more susceptible audiogenic convulsions than normal rats, and, therefore, if the adult deprivation was



g. 1. Mean hoarding scores for each rat in the experimental and control groups on all trials. (The abscissa represents the number of hoarding trials, and the ordinate the number of pellets hoarded. The experimental group is indicated by a continuous line and the control group by a dotted line.)

ore frustrating to the experimental group than to the controls we would expect the rmer to show a greater incidence of convulsions than the latter. To test this hypothesis animals were put through the same procedure beginning on the 288th day. They were aced in a wooden box (dimensions $9 \times 12 \times 7$ in.), with a wire-netting lid and floor, in nich was a loud electric bell. The bell was rung for 2 min., and the rats were rated on a point scale for convulsive behaviour during and after the bell ringing. The first trial as done on satiated animals, after which the animals were returned to their cages and sted for 3 days. On each of these days the rats were subjected to the convulsive pro-dure. With only one exception (Table 6), the controls showed an unexpected greater sceptibility than the experimentals, but a t-test showed that all the differences except o could be attributed to differences of random sampling. Considering the mere incidence convulsions in the two groups we find, by applying the χ-squared test (with a correction

for small numbers (9)), that the superiority of the control group over the experimental could be expected to occur by chance in as many as one case in five (Table 7).

No valid conclusions can be drawn from these few data but there is presumptive evidence that there may be some difference between the two groups and that it is in the direction of an increased tolerance to frustration in the experimental animals.

Table 6

Day	Convulsive behaviour (mean rating) Experimental	Control	Mean difference	*P*
(*a*) Difference in convulsive behaviour between groups rated on a 5-point scale during bell ringing				
1	2·15	2·57	0·42	0·05—0·10
2	2·31	2·57	0·26	0·40
3	2·15	2·50	0·35	0·1 —0·2
4	1·77	2·15	0·38	0·02—0·05
(*b*) Differences in convulsive behaviour between the experimental and control groups rated on a 5-point scale after bell ringing				
1	1·85	3·00	1·15	0·1 —0·2
2	2·85	3·36	0·51	0·4 —0·5
3	1·31	2·68	1·37	0·01—0·02
4	2·38	2·29	0·09	0·2

Table 7. *Convulsive reactions to bell-ringing in experimental and control groups*

	Experimental group	Control group	Total
Animals showing convulsions	0	5	5
Animals not showing convulsions	52	56	108
	52	61	113

$\chi^2 = 1{\cdot}506$; D.F. $= 1$; $P = 0{\cdot}20$.

IV. Conclusions

There is no doubt that our experiment confirms the original findings of Hunt (2) on hi 24-day group. It does, however, produce new findings which are difficult to explain Hunt (2) observed that infant feeding-frustration commenced as late as 32 days after birt had no effect upon adult hoarding behaviour, whereas our results clearly show tha frustration in adult life will have as great an effect as early deprivation commencing on th 24th day. This result could be reconciled with the findings of Hunt on his 32-day grou if it were found that the differences appeared again after a period of rest from hoardin for under these conditions we would be free to assume that the effect of adult experienc though equal in the sense that it temporarily reduces the difference between the tw groups, is less enduring. We did not attempt to determine whether this was so, but th fact that the difference in hoarding is still present at the end of the third run indicates tha the expected finding would be unlikely to occur.

There is an alternative explanation. We observed that the experimental anima started to hoard food during the period of infant deprivation, many taking small balls wet mash into the back of their cages to feed there. The control animals showed n tendency to hoard during this period, always eating from the dish placed near to the cag door. It seems likely that the experimental animals learned to hoard in infancy where the controls did not, and, therefore, when placed in the hoarding alleys in adult life had a advantage over the control group. However, after the practice of the first run the contr group equalled the experimental animals in hoarding speed and thereafter the differen

appeared. On this hypothesis the difference between the two groups (so far as the arding habit is concerned) is merely one of practice. If this is so, then support is given the views of Hunt(3) and Marx(7) that the observed differences in hoarding between fant-deprived and normal animals as well as hoarding behaviour itself are the result of rning.

This hypothesis does not exclude the existence of behavioural differences between the o groups which cannot be equalized by additional practice by the controls. Our qualita- e findings make it appear as if the rat deprived in infancy responds with greater activity d sensitivity to a given adult deprivation than do fully fed animals subject to the same privation. Also, the continuous experience of frustration in adult life does not appear produce the same effect in this respect as infant deprivation. These results can only ean that the infant-deprived animal suffers a more or less permanent intensification of ive in response to a given adult deprivation.

The experiment clarifies the clinically derived concept of fixation, demonstrating, as it es, that the permanent and essential difference between animals who, at first, show ation of a response as a result of infant deprivation, lies not in the specific response (or strumental act) but in an intensified drive manifestation, to which the fixated instru- ental act is secondary. This conclusion confirms the psychoanalytical view(1) that tense frustration of a drive in infancy will have the effect of causing minor frustrations adult life to lead to an impending traumatic state—a state which is nothing more than heightened manifestation of drive. Our hesitant conclusion that the behaviour of the perimental animals in adult deprivation appeared 'anxious' gives further confirmation the psychoanalytic view, for an impending traumatic state is believed by the psycho- alysts to be an anxious unpleasant state, as well as a heightened manifestation of drive. he instrumental act may be regarded, as the psychoanalysts would maintain it to be, as secondary mechanism defending the animal against the unpleasant traumatic state. ur experiment thus directs attention away from the hoarding itself towards the more ndamental effect of infant deprivation on drive manifestation.

The increased rate of decrease in hoarding from run *a* to run *b* (Fig. 1) may imply that oth groups develop a frustration tolerance in the course of the experiment, and there is ight evidence from the convulsive experiment that the experimental group ultimately ow a greater tolerance than the control. This latter finding is paradoxical in the light of inical findings but gives some support to the popular view that the neurotic who breaks own will, if immediately confronted with the situation which caused him to break down, ow less tendency to relapse.

SUMMARY

1. A modified repetition of Hunt's(3) experiment designed to determine the effect of fant experience upon adult behaviour is described.

2. The original conclusions of Hunt concerning the effect of infant experience upon dult behaviour have been confirmed for the 24-day group.

3. It was observed that the hoarding difference between the animals frustrated in fancy and those who were fully fed disappear if sufficient hoarding practice is given.

4. However, general behavioural differences of a kind involving 'drive', between the wo groups, were observed and these differences were maintained until the end of the xperiment. The experimental group appeared to show a more marked reaction to adult eprivation than the controls.

5. There was evidence that both groups developed a tolerance to food deprivation i the course of successive periods of absolute deprivation, and there was an indication tha the experimental animals were superior in this respect.

6. The relation of the findings to the psychoanalytic concepts of the traumatic stat and of fixation is discussed.

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MANUAL TRACKING IN RESPONSE TO THE DISPLAY OF HORIZONTAL, VERTICAL AND CIRCULAR SCALES

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I. *The problem* (p. 155). II. *The apparatus* (pp. 155–157). III. *Experiment* 1 (pp. 157–162). IV. *Discussion* (p. 162–163). V. *Summary* (p. 163). *References* (p. 163).

I. The problem

The design of visual indicators has been the subject of many experimental investigations in recent years. Emphasis has been laid on a wide range of design variables but one aspect of the problem which has received relatively little attention concerns the shape of the display.

Vernon (4), Sleight (3) and Grether & Connell (1) appear to be the only workers who have considered the relative advantages of linear and circular scales. The results of even these experiments, however, are limited in their application and there is ample scope for more data on the subject.

The purpose of the present investigation is therefore to assess the speed and accuracy of the human response to reading a numerical scale arranged either as a horizontal or vertical strip, or as a circular dial. It is intended to approach this from three directions.

(1) As an experiment in manual tracking in response to a changing display.

(2) As a study in the setting of scale pointers to given readings.

(3) As a tachistoscopic survey of the accuracy of reading displayed scales.

It will be of interest to compare the general results of these three different attacks and so to gain experience in the methodology of this type of problem.

This present paper, however, is devoted only to a description of the apparatus used in the tracking experiment, together with some preliminary results.

II. The apparatus

An apparatus (Fig. 1), has been made for carrying out the tracking and setting experiments. The subject sits before the display below which is a control knob. A cam follower introduces, through a differential gear, the intermittent motion of the pointer over the display. A graphic record is made of the disturbances which have been introduced and the actual movements of the pointer over the display when controlled by the subject.

(1) *The control and display panel*

The control knob and dial are mounted centrally on a black panel 4 ft. wide by 18 in. high, which screens the rest of the apparatus from the subject being tested.

Three interchangeable types of scale and pointer can be fitted, one circular, one horizontal and the other vertical, as shown in Fig. 2. The numbers and scale markings are in white ink on a black background and are of the dimensions indicated in the figure.

To move the pointer from 0 to 10 on the scales the control knob, which is $2\frac{1}{2}$ in. in diameter, has to be turned through 360° in a clockwise direction.

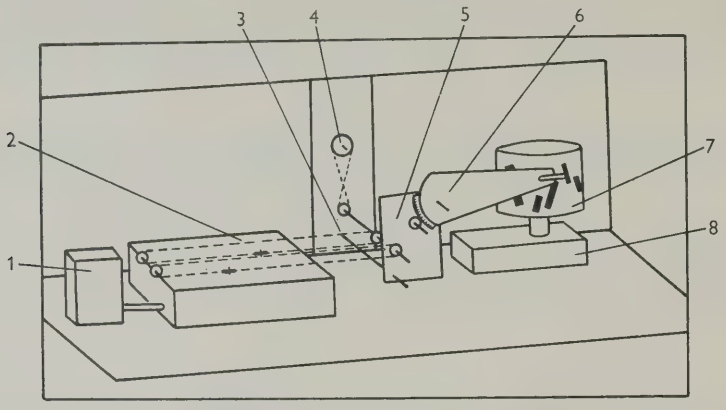

Fig. 1. Diagram of apparatus from the back. 1, recorder motor; 2, graphic recorder; 3, shaft to control knob; 4, pointer pulley; 5, supporting plate for differential; 6, cam follower; 7, cam drum; 8, motor driving cam drum.

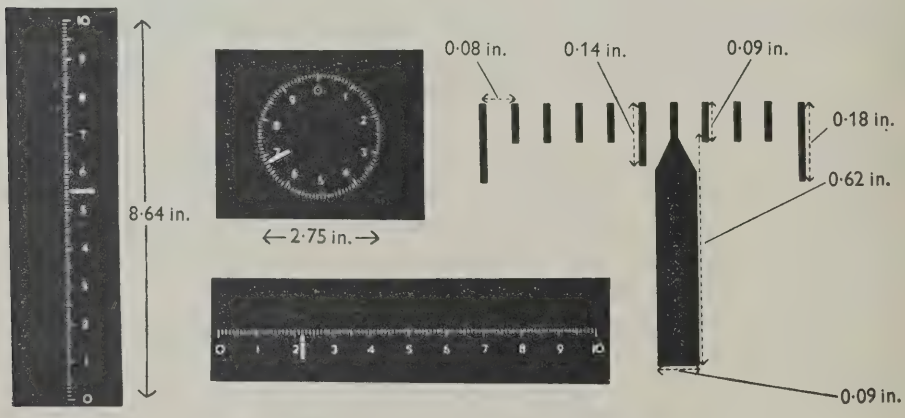

Fig. 2. Photographs of scales and diagram to show dimensions.

The three scales are comparable in every respect except that of shape. For example, the circumference of the circular scale is equal to the length of the linear scales and the length at the tip of the pointer on the circular scale, which is painted white, is equal to the length of the pointers on the linear scales.

(2) *The disturbance mechanism*

A ball race, fitted to the end of the cam follower arm, engages the edges of strips o plastic cut to any desired shape, and screwed to the cam drum. An electrical gramophon motor drives the drum in a clockwise direction.

In the present experiment, step-type disturbances of constant velocity are produced b means of fourteen straight edged strips, seven in each direction. The drum revolves a 2 revs. per min. which means that the disturbances occur at the rate of 28 per min., a average of one every 2·1 sec. Further particulars about the disturbances are given i Table 1.

Table 1. *Particulars of disturbancees at a standard drum speed of 2 revs./min.*

Disturbance sequence	Interval between* disturbances (sec.)	Duration of disturbance (sec.)	Pointer displacement (in.)	Velocity of disturbance (in./sec.)
1	2·2	0·5	−1·21	2·4
2	1·8	0·4	−0·95	2·4
3	1·0	0·8	+2·63	3·3
4	1·3	0·9	−1·92	2·1
5	0·9	0·9	+2·95	3·3
6	1·1	0·3	+0·76	2·5
7	1·4	0·7	+1·52	2·2
8	1·4	1·1	−3·64	3·3
9	1·8	0·6	+1·77	3·0
10	0·9	1·8	−4·84	2·7
11	2·1	0·9	+3·13	3·5
12	1·1	1·1	+2·91	2·6
13	1·0	0·5	−1·61	3·2
14	1·1	0·5	−1·52	3·0

(3) *The recorder*

The recorder consists of six pen trolleys, sliding in rails, which are mounted above horizontal glass plate across which paper is fed at a constant speed. Small stylus type as fit into holes in the trolleys and bear on the paper by gravity. The writing points e spaced half an inch apart.

In the present work the paper is drawn through the recorder at the rate of 16 in. per n. Three of the six pens are used. One stationary pen gives the base line which shows e position of the target on the record. The motion of the cam follower is communicated a second pen so that an exact record is kept of the disturbances which have been roduced. The third pen is controlled by the output shaft from the differential and erefore records the actual movements of the pointer over the display. This is the gebraic sum of the disturbance put in and the subject's response.

III. EXPERIMENT 1

To compare the speed and accuracy of manual tracking in response to the display of horizontal, vertical and circular scales

Procedure

Eighteen subjects took part in this experiment, all male University students. The rpose of the investigation was explained to the subjects in groups of six. They then urned individually to be tested. Each member of a group tackled the three displays, rizontal, vertical and circular, in a different order so as to eliminate as far as possible e effects of learning and fatigue.

Before each test the subject was allowed to handle the control for about 15 sec. in order discover the relation between direction of rotation of control knob and direction of ovement of the pointer on the scale. A practice run of 1 min. was then given, followed the test run which lasted 2 min. There was an interval of about 4 min. in between each t, during which the display was changed.

The number '5' was chosen as the target on the linear scales and '4' on the circular le. It was considered that '5' would be an unsuitable target on the circular scale as it resented a unique vertical position of the pointer, to maintain which subjects would t need to look at the scale at all. They were told that the pointer would inevitably move

* These figures represent intervals between the 1st and 14th, 1st and 2nd, 2nd and 3rd, etc. disturbances.

away from the target as disturbances were put in, but by turning the control knob they must bring it back as quickly and accurately as possible. It was emphasized that the distance moved away from the target and the time spent 'off the mark' would be taken into consideration in assessing the error.

(2) *Scoring*

A typical record is shown in Fig. 3. The pen which traces the subject's response is an inch in front of the pen which records the disturbances and it moves in the opposite direction. In Fig. 3, therefore, the first four of the fourteen disturbances encountered in one revolution of the drum have been numbered to correspond with their respective responses. A scale representing that on the display has been added to show the magnitude of the error.

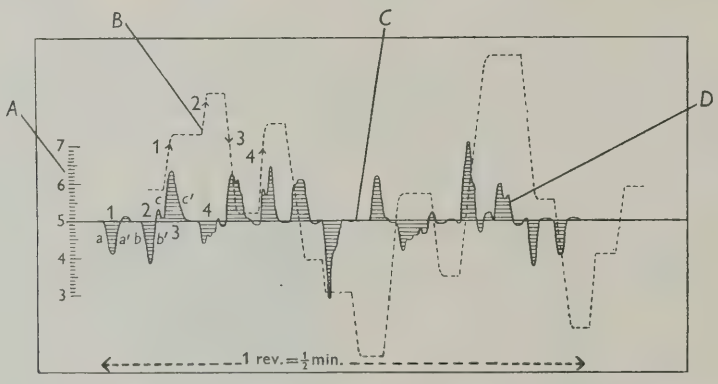

Fig. 3. A typical record. *A*, portion of scale as on display; *B*, record of disturbances; *C*, target base line; *D*, record of pointer movements on display.

To find the best way of scoring such a graphic tracking record three methods were investigated and applied to a number of records so that the resulting scores could be correlated. For this purpose the error accumulated in half a minute during one revolution of the cam drum was considered as the unit to be scored.

Method 1. *Integration of speed and accuracy.* The error, or discrepancy between the pointer and the target, can be determined from the record at any moment during the test run. Measurements were first made of the total time during which the error exceeded certain specified values in the course of one revolution of the cam drum. For example the total time during which the distance between the target and the pointer exceeded 0·5 scale divisions would be found by adding together the lengths marked aa', bb', cc', etc. along the record (Fig. 3). A special record analyser is used for this. Let the values obtained at 0, 0·1, 0·2, 0·3, etc., scale divisions from the target be denoted by t_0, t_1, t_2, ..., t_n. A fairly accurate estimate of the area under the tracking curve can then be obtained from the formula:

$$\text{A (i)} = t_1 + t_2 + t_3, \ldots, t_n + \tfrac{1}{2}t_{\frac{1}{2}}.$$

(The value of $t_{\frac{1}{2}}$ is found by interpolation between t_1 and t_0.)

This area is shaded in Fig. 3. It is taken as an index of the speed and accuracy of the subject's response and is for practical purposes considered as the sum of the areas of a series of rectangles. The unit adopted is a 'division-second' which can be defined as an area on the record of dimensions 1 sec. by 0·1 scale divisions.

n an attempt to reduce the time required for scoring, an estimate of the area obtained his way was compared with estimates of the same area obtained by taking measure-nts (a) at every second division 0·1, 0·3, 0·5, etc., and (b) at every fourth division 0·6, 1·0, etc. The corresponding formulae would therefore be:

$$A\,(ii) = 2(t_1+t_3+t_5 \ldots),$$
$$A\,(iii) = 4(t_2+t_6+t_{10} \ldots).$$

Table 2 gives the values obtained for six different records when assessed by the three nulae. The figures represent the error accumulated in half a minute during one olution of the cam drum. All these records were obtained using the vertical scale.

Table 2. *Comparison of scoring techniques*

Positions at which measurements are taken on record	Area under tracking curve: Divisions × seconds — A (i) Measuring at 0, 0·1, 0·2, 0·3, etc. Scale divisions from target	A (ii) Measuring at 0·1, 0·3, 0·5, etc. Scale divisions from target	A (iii) Measuring at 0·2, 0·6, 1·0, etc. Scale divisions from target
Record I	94·4	93·5	88·8
II	95·0	93·4	87·9
III	98·4	95·2	93·2
IV	110·0	109·8	106·6
V	121·2	118·3	114·0
VI	127·4	125·7	122·7

Estimates of the area under six tracking curves showing the effect of increasing the interval between measurements.

t will be seen that in these particular cases the values obtained by making less frequent asurements are systematically smaller. It was concluded, however, that as the values ained are used only for purposes of comparison and not as absolute quantities it is quate to measure only t_2, t_6, t_{10}, etc. With this method there is a 75% saving of time he cost of no appreciable loss in accuracy.

Method 2. *Proportion of time spent off the target.* A second method of scoring is to asure, on the record, the time spent off the target irrespective of the error, during the rse of one revolution of the cam drum and to express this value as a percentage of the al time of the run. This involves measuring t_0 only. The correlation between these two thods of scoring was considered and though in most cases it was fairly close there were or two gross exceptions. This was undoubtedly due to the fact that a subject might centrate on keeping the needle close to the target but ignore deflexions of the order ·05 scale divisions. Thus, though the error as represented by the area under the curve ght be small the percentage of time spent off the target might be very large. For this son the target area was expanded and considered as the specified value plus or minus scale divisions. The instructions given to the subjects were unaltered and their task still to try to keep the pointer on the specified value but it was found that the pro-tion of time spent off the target was reduced on an average from about 72% to about % by increasing the target area.

Method 3. *The 'mean error'.* The customary method of scoring graphic tracking records o take frequent measurements of the error at given intervals of time and determine 'mean error'. This was done on twenty-four records (six from each of four subjects) ich had already been scored by Methods 1 and 2, in order to compare the three methods.

Measurements of the error were made every $\frac{1}{16}$ in. As a record lasting 30 sec. (the duratio of one revolution of the drum) is 8 in. in length this means that 128 measurements of th error were made on each record, i.e. the error was measured every 0·23 sec.

An error of $\frac{1}{16}$ in. on the record represents a discrepancy between the pointer and th target of 0·1 scale divisions. The error was therefore read directly to the nearest 0·01 scal divisions.

Correlation between the three methods of scoring. The results obtained from twenty-fou records, by the three methods of scoring described, were compared and the followin correlation coefficients determined:

Between Methods 1 and 2	+0·441.
Between Methods 1 and 3	+0·953.
Between Methods 2 and 3	+0·486.

It is apparent that the area under the tracking curve is proportional to the 'mean erro whereas the percentage of time spent off the target measures some other characteristic.

In this case, however, a preference is felt for the area under the tracking curve fo a number of reasons:

(1) It is easier to make precise readings when measuring at right angles to the directio of motion of the pen, i.e. when cutting across the waves.

(2) The area under the curve is less subject to sampling variations than the 'mean error' The tracking curve fluctuates violently between ±3 scale divisions and it was shown tha even with 128 separate measurements, the 'mean error' could vary between ±11% b starting to measure at a slightly different point on the same record.

This difficulty is overcome by taking measurements parallel to the centre target lin Such values become systematically smaller as the distance from the target is increase and, as has been shown, the interval between readings can be increased considerabl without undue loss of accuracy.

(3) *Results*

For the purpose of the main experiment the error accumulated in 1 min. during 2 rev of the drum was considered as the unit to be scored. Consequently, the first and last ha minutes of the test run were not included in the subject's score. Method 1 of scoring wa adopted and the area under the tracking curve determined in division-seconds.

A record was also kept of the number of times, out of a total of twenty-eight response that each subject turned the control knob in the wrong direction thereby increasing th error rather than reducing it.

Table 3 contains the basic data. It shows the scores of the eighteen subjects on th three scales and the order in which they were displayed.

Fifteen out of eighteen (83%) of the subjects in this experiment obtained their be scores on the horizontal scale. Moreover, fewest mistakes are made in handling the contr when tracking on this scale. Individually, however, there is no correlation whatev between the error as determined by the area under the tracking curve and the numb of times the control is mishandled. Subjects 5 and 7, for example, have large tracki errors and yet they very seldom turned the control the wrong way. Subject 9, on the oth hand, shows extremely good tracking performance with no mistakes at all in the use of t control while subject 14 made a total of fifteen mistakes and yet has a relatively low sco

The means derived from the basic data are given in Table 4.

Table 3.

	Display presentation order			Tracking error (Area under curve) Divisions × seconds			Control mishandled No. of times		
ubject	Hori-zontal	Vertical	Circular	Hori-zontal	Vertical	Circular	Hori-zontal	Vertical	Circular
1	1	2	3	198·2	216·8	208·3	0	7	1
2	2	1	3	129·2	185·3	161·5	7	15	10
3	3	2	1	126·5	168·5	162·5	4	10	10
4	1	3	2	136·5	154·5	153·2	5	6	5
5	3	1	2	206·9	229·4	237·5	0	1	0
6	2	3	1	121·5	185·7	149·5	4	5	6
7	3	1	2	201·4	162·5	197·0	0	2	0
8	1	2	3	142·2	192·3	167·6	2	6	3
9	2	3	1	114·8	123·2	117·8	0	0	0
10	1	3	2	131·5	139·5	117·9	3	4	2
11	2	1	3	145·7	185·0	189·3	0	0	4
12	3	2	1	196·8	200·2	232·5	0	4	0
13	1	2	3	164·5	162·3	160·4	0	3	1
14	2	3	1	128·2	139·6	153·0	4	8	3
15	3	1	2	112·9	172·7	146·2	1	5	5
16	1	3	2	198·5	263·5	203·2	1	3	3
17	3	2	1	143·2	215·0	196·8	5	1	1
18	2	1	3	123·0	218·5	133·9	1	7	4

To show, for each subject, the order of presentation of the displays, the tracking error and the frequency of turning the control the wrong way.

Table 4. *Mean scores for eighteen subjects*

	Tracking error (area under curve) Divisions × seconds		Control mishandled (no. of times)	
	Mean	±S.E.	Mean	±S.E.
Display:				
Horizontal	151·2	±8·0	2·0	±0·54
Vertical	184·1	±8·5	4·8	±0·90
Circular	171·6	±8·4	3·2	±0·62
Order of presentation:				
1st	174·3	±8·0	3·4	±0·97
2nd	165·1	±9·5	3·4	±0·69
3rd	167·5	±9·2	3·3	±0·69

Here it can be seen that the horizontal scale gives the lowest error score and also the nimum number of mistakes in the use of the control. The vertical scale, on the other nd, gives the highest error score and the maximum number of mistakes in the use of control. The order of presentation appears to make no systematic differences to the formance.

The individual differences, those due to the displays themselves and their order of sentation, are analysed further in Table 5.

Clearly, whether one considers the tracking error or the number of times the control is shandled, the individual differences and those due to the displays are highly significant $\leqslant 0{\cdot}001$). The differences due to the order of presentation of the displays, on the other nd, may well be due to chance ($p > 0{\cdot}2$).

When the significance of the differences due to the displays had been established tudent's t test was applied to find out between which pairs of means the difference is st significant. The values of t obtained are given in Table 6.

Table 5. *Analysis of variance of the data given in Table* 3

Source	Sums of squares	Degrees of freedom	Variance	*F*	*P*
Tracking error (Area under curve):					
Between persons	49318	17	2901	7·6	⩽0·001
Between displays	9950	2	4975	13·9	⩽0·001
Between order	810	2	405	1·07	Not significant
Residue	12168	32	380	—	—
Total	72246	53	1363	—	—
Control mishandled:					
Between persons	382·6	17	22·5	6·7	⩽0·001
Between displays	70·0	2	35·0	10·4	⩽0·001
Residue	114·0	34	3·35	—	—
Total	566·6	53	10·69	—	—

Table 6. *Application of Student's t test to data given in Table* 3

	Tracking error (area under curve)		Control mishandled	
	t	*p*	*t*	*p*
Difference between the means of:				
Horizontal and vertical	4·2	⩽0·001	4·0	⩽0·001
Horizontal and circular	4·7	⩽0·001	2·14	⩽0·05
Vertical and circular	1·8	⩽0·1	2·76	⩽0·02

It may be concluded now that, for the purpose of tracking, a horizontal scale i significantly better than either a vertical or a circular scale when used in conjunctio with a circular control knob. The circular scale appears to be slightly better than th vertical but this difference has not yet been shown to be very significant. Conclusion relating to the circular scale are, however, only valid for a target in the lower segmen (position 4 on the scale). Other targets must be considered separately.

IV. Discussion

In the past, comparisons of the legibility of various displays have mostly been based o the tachistoscopic technique, and the speed and accuracy with which a display can b read has been the criterion of excellence which has been adopted. There is no doubt tha this time-honoured method is valuable, and moreover it is simple to administer, but o the other hand it investigates only the display half of the 'psychological reflex arc', an it does not treat the display and control problem as a whole. In practice a machin operator does not usually put the information received from the display merely int words, or even write it down. He translates it into action, or potential action, and th more this is true and the quicker the time relation of the reaction the more importan it is to have a clear display.

However, as this experiment suggests, as soon as a control task is introduced into th problem it becomes apparent that it is the relation between display and control whic is of primary importance. If this relation is one which the subject finds easy then the will be little hesitation in selecting the right response. If, on the other hand, there is an doubt in the mind of the subject as to which way to turn the control in order to countera the disturbance then he will do one of two things. Either he will make a hasty decisio at the risk of increasing the error rather than reducing it, or else his reaction time wi

e increased. As Mitchell(2) points out, this relation is more important when performing discontinuous task involving responses to discrete stimuli. In response to a continuously hanging stimulus the relation between the control and the display appears to have little ffect on the accuracy of the performance.

V. Summary

1. An apparatus is described for studying the speed and accuracy of manual tracking response to a displayed scale arranged either as a vertical or horizontal strip or as circular dial. The scales are comparable in every respect except that of shape.

2. The apparatus consists of a display and control panel, a cam follower which introuces disturbances of known and easily adjustable characteristics and a multiple ink ecorder.

3. The task is to sit in front of the control and display panel and to maintain the pointer etting on a given scale reading notwithstanding the disturbances which are introduced.

4. The graphic record of speed and accuracy is converted into figures by a special echanical device which measures the lengths of time for which errors of given magnitude re exceeded. The frequency with which this measurement needs to be made, in order to stimate the area under the tracking curve, is discussed and this method of scoring is orrelated with other known methods.

5. It is concluded that in a tracking task of this nature, with a circular control knob, he speed and accuracy of the subject's reaction is significantly better in response to the orizontal scale than to either of the other two displays. But this refers only to a target the lower segment of the circular scale.

6. A record is kept of the number of times the control knob is turned the wrong way the attempt to counteract a disturbance. Significantly fewer mistakes are made in esponse to the horizontal scale. Individually, however, there is no correlation between he tracking error as determined by the area under the curve and the number of times he control is mishandled.

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ELECTRONIC AIDS FOR BLIND PEOPLE

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From the Experimental and Research Department of St Dunstan's

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I. Introduction

The investigation described below was carried out as part of a programme of research by St Dunstan's into the possibilities of electronic aids for blind people. The devices concerned were of two types, guiding aids and reading aids: the former intended to make up to some extent for the loss of distant vision and the latter to make available to blind people the large amount of literature not available in braille.

II. Guiding aids

(i) *Basic principles*

When, at the end of the war, the principles of radar became known many people felt that there might be some possibility of applying the same principles in a portable device. If this enabled blind people both to detect and avoid obstacles they might be able to find their way about without escort to a greater extent than before.

Experimental work in this country and in the United States aimed to investigate thoroughly all the various possibilities, to discover whether any of the wartime advances in technique could be applied and, if not, what further advances would be necessary before a practical guiding device could be made.

In attempting to design suitable devices to be tested out with the assistance of blind people the basic principle of a radar equipment was adopted, that is, when the exploring beam is intercepted by an object the latter reflects some of the energy in the beam back to the instrument where it is detected and thus informs the user of the presence of an obstacle. The character of a radar beam, and in particular the wave-length, makes it unsuitable for locating small objects at ranges of a few feet. Because of this it is necessary to look round for some other form of exploring beam. The most promising alternatives being beams of light and beams of sound and ultrasonic energy, various devices using each were constructed. Details of the design of these have been given elsewhere(1).

(ii) *Preliminary tests on 'obstacle sense'*

Before the various devices were ready, preliminary tests were made in an attempt to ascertain whether the blind man's ability to 'sense' the presence of obstacles was entirely accounted for by his interpretation of echoes from them. Many blind people who have the ability to sense obstacles do not attribute it to hearing. Because awareness of an obstacle is frequently accompanied by a 'tingling' sensation on the face they are apt to explain it in terms of some sense vaguely described as 'facial vision'.

These tests were made in a sound-proof room $8 \times 10 \times 8$ ft., and the blind man co-
perating in the test was seated near the centre of the room, while objects of various shapes
ere supported in positions unknown to him. He was then asked first to point out their
osition and secondly to touch them. It was found that great care had to be taken in the
ill room to avoid making even the slightest sound when placing the objects in the test
osition. Even the rustling of a sleeve was enough to give away the position and it was
und useful to provide some distracting sound, such as someone talking, while the object
as being placed in position. If the blind man remained absolutely still and there was no
her sound present in the room, he was unable to detect the object at any distance unless
s temperature was sufficiently different from the ambient temperature. For example,
hand may, with difficulty, be detected a foot away by the heat radiated from it.

When the blind man was allowed to make sounds of his own choosing he was able to
etect readily any objects of more than about 1 sq.ft. projected area within 4–5 ft. unless
ese objects were facing in such a direction that no sound could be reflected directly back
wards his ears. Preference was shown for a sharp sound such as the click produced by
apping two fingers together, except when an object within 2 ft. was being located, when
rustling sound or a hiss appeared to give more assistance. Location of an object was
ndered considerably easier if the blind man was allowed to alter the position of the sound
urce. This presumably altered the strength of the sounds reaching his ears directly,
lative to that reaching his ears via the object, and provided additional information on
hich to base his judgement. Detection of any object, however large, became very
fficult and extremely unreliable immediately the range of the object became comparable
ith the distance to the nearest walls of the room. It is probable that this difficulty was
used by masking of the reflexion from the object by the many reflexions from the walls
the room.

The accuracy with which the object could be located was difficult to estimate. The blind
an was first asked to point in the direction of the object and state its distance in terms
some unit, such as feet or arm's lengths, with which he was familiar. Unfortunately,
ind people as a whole have a very poor sense of the position of their hands and arms.
his is of course understandable, since they are never able to correct positional errors by
ght. In consequence a blind man concerned in these experiments might, while having
clear idea as to where the object was, indicate its direction inaccurately, being frequently
n or twenty degrees out, usually with a considerable bias in one direction. It was in order
eliminate this difficulty that the blind man was also asked to touch the centre of the
ject, and he was normally able to do this with an error of seldom greater than five
grees. In the same way errors in estimating the range arose largely from a misconception
to how far '1 ft.' really was. Though able to demonstrate by touch that he knew the
stance of an object a blind man would frequently give a much less accurate verbal
timate.

Various artificial sources of sound were tried as an aid to location, including tones,
ermal noise and single and repeated pulses of sound with a variable frequency content.
general, high-pitched pulses of sound or 'clicks' showed a marked superiority, though at
ort ranges thermal noise appeared as effective for detecting and locating objects provided
e high frequency content was not removed. The important qualities in the pulses
peared to be the shortness of the pulse and the presence of high audio frequencies. If
ese two factors were present the other characteristics mattered little. If the blind man

was allowed plenty of time to locate an object he preferred to do it by producing single pulses under his own control and in this way was able to obtain an accurate idea of the object's position. If the object was only present for a short while it was found better to provide a succession of pulses at a fast rate, this making it possible to estimate the object's position most accurately in a short period. It was, however, necessary to limit the repetition rate when searching for distant objects to prevent the echo being masked by the following pulse. For distant objects it was also found advantageous to shield the source, thus reducing the sound reaching the ears directly.

(iii) *Comparison of devices*

On the basis of these preliminary tests it was decided to construct one acoustic device working at audible frequencies. In this the internal detector for echoes could be omitted as the user could listen directly to the sound reflected from any obstacle. When a practical comparison of the various devices was made it was found that this device in particular stood out as being more popular. The principal reason for this appeared to be that a wide beam of sound could be employed, since directional location of the audible echo could be accomplished binaurally and did not depend on the narrowness of the beam as in the other devices. The wide beam of sound eliminated the lengthy scanning procedure, which is unavoidable if the user of a narrow beam device wishes to make certain that no obstacle is missed but which renders progress unduly slow. This device, the 'Clicker' also had the advantage in weight ($1\frac{3}{4}$ lb.) and battery life (750 hr.) over the devices incorporating an internal detector for the reflected energy. Another advantage of omitting the internal detector and amplifier system is that all the information which may be obtained from the nature of the reflexions from an object is preserved intact. Much of this is lost if the echo is heard through an amplifier because of the unavoidable distortion when the power consumption must be reduced to a minimum and the sensitivity kept high.

(iv) *Field tests*

For the reasons just given, and to reduce the considerable time which thorough training in the use of each device involves, it was decided to test only the 'Clicker' device extensively. Several groups of blind people, including children at three schools in the London area, were given instruction in its use. At these schools the instruction culminated in a test in which the children had to find their way along an unknown route, some with the assistance of the clicker and some without it. Those who made the outward journey with the clicker returned along the same route without, and vice versa. They were timed on both journeys and note was made of the number of times it was necessary to correct one of them who had departed from the correct course. It is proposed to quote the results of these tests in detail as they are typical of the conclusions arrived at with the other groups of blind people.

At the first school the test route ran through streets in the neighbourhood of the school which were previously unfamiliar to any of the children. It was chosen because it provided a variety of different situations such as a blind person might expect to encounter. For 30 yards it was necessary to find a way along a gravel path between scattered bushes, then a left turn led on to a pavement beside a road carrying fairly continuous traffic. This road was provided with additional obstacles in the form of a bus stop and a belisha beacon. After 84 yards the route turned left again on to a pavement beside a quiet street in which there was a large number of obstacles. The first of these was a telephone box projecting

m the fence and the second a wide break in the fence where a drive entered private ounds. Beyond this a row of eight trees and one lamp post, irregularly spaced, flanked e fence. The distance from the corner to the end of the street was 120 yards.

Before departing the children were given a brief description of the route but were not ormed of the position of any of the obstacles which have been mentioned. It was iceable that, especially on the outward journey, those with the clicker were more at ease n those without who seemed, in some cases, afraid of the possibility of colliding with ne obstacle. Of the five children who returned without the clicker three made considerable e of the knowledge, gained on the outward journey, that there was a fence running ide them nearly the whole length of the route. They touched this every two or three es and were thus able, in some cases, almost to run back. The other two made use of tfall echoes from the same fence, one of these returning entirely without touching the ce. Those returning with the clicker obviously felt that they were expected to return h its aid alone and refrained from touching the fence.

The mean times taken by the children covering the course are given in Table 1.

Table 1. *Mean times taken by children to cover the course* (*ten children aged* 11–15)

Journey	Mean time (min.)	Standard deviation (min.)
Outward with device	4·96	1·7
Outward without device	7·08	2·7
Inward with device	4·24	0·94
Inward without device	2·56	0·47

n the second school, one test route ran down a street with houses on both sides for about yards and then continued down a narrow lane for 170 yards with a grassy bank surunted by a hedge on either side. In this section there were several open gateways where ves passed through the bank into private grounds. After descending a small hill for 3 yards the route turned to the right out of the lane into a newly made unfenced road ning across a field in which new houses were being built. As there was no well-defined ge to the road here, the route had to be followed by noticing the different surfaces derfoot at the side of the road. A further obstacle in the form of a parked shootingke stood in a direct line from the corner to the end of the route 40 yards farther on. Errors were made by several children, the commonest being to turn to the right up one the several drives instead of waiting till they reached the road junction. None of them de this mistake on the return journey. On reaching the junction none failed to turn ht but many, instead of turning at right angles to their previous direction, went iquely across the road. This may have been partly due to the misleading effect of the pe of the ground and partly to the absence of any guiding fence by the side of the road. st of the children liked using the clicker and two inquired when it would be possible them to have one of their own.

The mean times taken by the children covering the course are given in Table 2.

Examination of the times in Tables 1 and 2 suggests that while on the unknown test ute the clicker affords some assistance, the reverse is the case on a known route, even if, n this case, the route is only being traversed for the second time, and that in the opposite ection. It is also clear that the experience gained on the outward journey results in a ch greater speed on the return journey whether the clicker is used or not. The probability statistical significance in the difference between the times with and without the clicker

on the outward journey is not great. The superiority of the clicker is significant on a 3% level by the '*t*' test only in the case of the first school. Taking both schools together the difference is significant on a 1% level. The difference between times on the return journey with and without the clicker is also significant on the 1% level. The most reliable evidence is in respect of the benefit of experience and is significant on the 0·1% level. It is also of interest to note that the standard deviation of times is very much lower on the return journey, showing that the speeds are less erratic.

A younger group of pupils aged 10–11, at the second school, went through a similar test over a shorter and rather simpler course running down a lane between steep banks, over crossroads and beneath a railway bridge. Only one error had to be corrected, that of a child who on the return journey lost all sense of direction at the crossroads and, turning completely round, would have gone back towards the bridge.

Table 2. *Mean times taken by children to cover the course* (*ten children aged* 14–18)

Journey	Mean time (min.)	Standard deviation (min.)
Outward with device	7·94	3·3
Outward without device	9·54	3·8
Inward with device	4·94	0·88
Inward without device	4·76	1·2

Table 3. *Mean times taken by children to cover the course* (*eleven children aged* 11 *and under*)

Journey	Mean time (min.)	Standard deviation (min.)
Outward with device	4·29	1·1
Outward without device	4·03	0·82
Inward with device	3·37	0·90
Inward without device	3·24	1·0

The third school catered for children from 5 to 10 years of age so a very short straightforward course was chosen for a test. If anything, it appeared that on this very simple course the clicker was a drawback rather than an aid since the children with it took great care to scan their path carefully. Those without, on the other hand, walked without hesitation along the footpath which formed the test route. Some of these used the oak-paling fence to one side either as an audible or tactile guide, others used the grass on either side of the path as an indication that they were straying.

As only a few children were concerned in each of the latter tests, and no significant differences existed between the two schools as regards the influence of experience and the use of the device, the results have been combined in Table 3.

Though the mean times with the clicker are slightly greater in Table 3 the result has no statistical significance. The reduction in the times required on the inward journeys is significant only on a 5% level.

(v) *The results*

The most important fact among the results just quoted is the greater ease and speed with which the course is covered the second time when it has become slightly familiar. It would appear that a device such as that used in these tests ceases to have any great use once a route and the positions of any obstacles along it are known. It would therefore be unlikely to become popular with capable blind people covering a well-known route regularly. What is not brought out by the figures quoted but seems of considerable

mportance is that while the blind children were being trained to use the device their apability at finding their way around without any device also increased considerably. Many blind adults too, in learning to use echoes produced by the artificial sound source, began to appreciate the rather more subtle echo pattern produced by their own footsteps. t is interesting to note that the mean speed at which the test courses were covered was $\frac{1}{4}$ m.p.h., a reasonable walking speed even for a sighted person.

(vi) *Conclusions*

In view of the foregoing we think that the desirability of deliberately training blind people in the art of 'getting about' cannot be too highly stressed. It is also thought that, while no guidance device can be recommended for regular use, a simple directional audio-frequency source such as that used in these tests might be invaluable as a training device for children and especially for recently blinded adults.

III. Reading aids

(i) *Conversion of print to a sound code*

The ideal reading machine would perhaps be one which would automatically scan the lines on a page of print, 'recognizing' the words over which it passed, and would pronounce these for the benefit of the blind user. While there is nothing fundamentally impossible in such a machine the expense would be prohibitive. Even attempts at automatic recognition of individual letters necessitate such elaborate instruments that their cost would be far beyond the reach of most people.

A more practical alternative instrumentally, is a relatively simple form of machine which converts the printed characters into a sound code which may then be interpreted by an experienced reader in terms of the letters which are being scanned.

Such an instrument, the Optophone, was made by Messrs Barr and Stroud in 1918, and though there have been recent attempts to make similar instruments none of these have come into use. The original Optophone was handicapped by the use of photocells less sensitive and stable than those now available and the sounds it produced were in consequence rather weak and variable. Alterations were made to a number of Optophones to improve them in this and other respects, and four blind people co-operated in a test to determine whether this type of instrument showed any promise as a practical aid which would be of real use to blind people.

One of the alterations was in respect of the sound code employed. The Optophone scans printed matter by means of six spots of light which cover a vertical cross-section of the line of print. This set of spots moves horizontally along the line so as to scan in turn all parts of each successive letter. As each spot of light falls on a black area of a print character a corresponding tone is heard by the reader, who is thus enabled to decipher the shapes of the letters and read the text. After experimenting with various combinations of tones with the co-operation of the blind readers it was decided that the chord G C D E $\overline{\text{B}}$ C made reading most easy and rapid.

(ii) *The blind readers*

Of the four readers, two had learned to read on the original Optophone a few years after it was first produced and had used it on and off up to about 1940, when there was difficulty in obtaining replacements for the selenium photocells. Both were keen to start using the Optophone again when the fitting of vacuum photocells made this possible. The other two

readers used the Optophone for the first time after the modifications had been carried out, one starting in the summer of 1948 and the other in the spring of 1949.

The progress of the four readers is shown in Table 4, the date quoted being the number of months from the date at which a modernized instrument was first received. The reading speed, which was measured line by line, is expressed in seconds per letter rather than seconds per word because it was found that the use of the former unit consistently gave the lowest variance between results for different lines. This is presumably because the number of letters in a line is a better measure of the difficulty of reading it than the number of words.

(iii) *Consistency of reading speed*

The column 'mean letters per word' is included as it gives some indication of the complexity of the words of which the text is composed. A correlation between the reading speed and the difficulty of the text might be expected. In fact, there is a slight positive

Table 4. *Reading speeds*

Test no.	Reader	Experience dating from	Date, no. of months from receipt of modernized instrument	Mean, seconds per letter	Standard deviation mean	Letters per word
1	E.	1948	3	5·8	0·38	3·8
2			6	7·5	0·56	4·3
3			10	2·3	0·52	4·6
4			12	2·1	0·44	4·3
5	F.	1926	4	1·2	0·54	4·1
6			4	1·6	0·94	4·4
7			4	1·1	0·23	3·9
8			7	1·0	0·29	3·9
9			7	1·4	0·41	4·2
10			10	1·9	0·65	4·2
11			13	0·81	0·50	4·2
12	H.	1949	2	4·3	0·66	4·0
13			4	2·3	0·51	4·1
14			7	1·2	0·48	4·3
15			10	0·98	0·21	4·0
16			10	1·0	0·31	3·8
17			13	0·98	0·29	4·3
18			13	0·95	0·21	4·2
19	J.	1918	6	0·45	0·35	4·1
20			6	0·34	0·23	4·1
21			10	0·34	0·36	4·1
22			10	0·30	0·07	4·0
23			11	0·34	0·33	4·9
24			11	0·33	0·22	3·9
25			22	0·33	0·28	4·1
26			22	0·30	0·55	4·3
27			22	0·37	0·81	4·2

correlation in each case between the reading speed and the length of word and between the standard deviation of the reading speed, expressed in terms of the reading speed, and the length of word. There is a much greater correlation (significant on the 1% level combining results for all readers) between the reading speed and the standard deviation suggesting that the mean length of word is only a minor factor contributing to the difficulty of reading a text.

Considering the readers individually it will be seen that while the two who had used an Optophone previously maintain a relatively constant reading speed the two new readers increased their speed markedly during the first 12 months of use of the instrument. The most experienced reader (J. in Table 4) maintains a consistent reading speed of about

words per minute and uses the instrument practically for checking (typewritten) :respondence and, to some extent, for reading matter unobtainable in braille. The erage reading speed of all four after the new readers had become familiar with the :trument was 20 words per minute. It is interesting to compare this with the average :ed of 130 words per minute at which these four readers can read braille and with an erage speed at which a book is read aloud, about 150 words per minute. The four ıders were all of high intelligence, having a mean I.Q. of 139 on a Terman and Merrill test apted for use by blind people.

(iv) *Conclusions*

These results show that unquestionably it is possible for an intelligent person, who is lling to persevere, to learn to read with such an instrument. The speed attained is, wever, limited and an appreciable effort is required during the learning period. For ese reasons it seems unlikely that the instrument would appeal to any but a very small inority of blind people who, for one reason or another, require to read matter not available braille and who are unable to obtain the assistance of a sighted reader.

IV. Summary

xperimental electronic aids for blind people have been constructed. These include ıiding Devices operating on the same principle as radar and Reading Devices intended enable blind people to read ordinary printed matter. Instruments of each type have :en tested with the co-operation of blind people. The results show that though both types aid can be of assistance under certain circumstances neither would be likely to achieve ıde popularity.

Reference

(1) Beurle, R. L. (1951). Electronic aids for blind people. *Electronic Engineering*, pp. 1–7. Jan.

(*Manuscript received* 20 *October* 1950)

COMPARISON OF PERFORMANCES IN ROAD-CYCLING TIME TRIALS BY INDIVIDUALS OF DIFFERENT CAPACITY

By NORRIE WARD

I. *Purpose of inquiry* (p. 172). II. *Procedure in trials* (pp. 172–173). III. *Collection of data* (p. 173). IV. *Comparison of performances at different distances* (pp. 173–174). V. *Variation of speed during performance* (p. 174). VI. *Distribution of capacity about the mean* (pp. 174–176). VII. *Conclusions* (p. 176). *References* (p. 176).

I. Purpose of inquiry

In a previous analysis (1), performances in road-cycling competitions were used as the basis for a study of the relationship between speed of operation and duration of task. In that analysis the performances investigated were those of experienced riders. An analysis has now been made of performances by riders of different classes, and the results are set out in these notes.

II. Procedure in trials

In road-cycling time trials, the times of all who complete a specified distance are recorded and are given in a result sheet issued subsequent to each event. Road-cycling competitions fall, in the main, into two broad groups: first, those which are open to all; and secondly those which are open only to riders of a certain class. In open events, the maximum number of entrants permitted in events at 25 miles is 120; in other events the maximum is 100. When more than the stipulated maximum number of entries is submitted for an event it is customary to select those riders who are adjudged from their past performances to be the faster, and to reject the slower and those who have no previous performances to their credit. In other cases, all entrants are accepted, provided they are members of recognized cycling clubs. Events other than open events may be restricted to 'longmarkers' (novices and inexperienced riders who have not beaten a certain standard or have not previously competed), or on the other hand to certain selected riders of championship class. The better class of rider is invariably one who takes care to bring himself to a high level of physical fitness and cycling efficiency, and who uses the most suitable equipment. Other riders do not necessarily prepare with the same thoroughness; some of them are only occasional competitors in speed trials. With few exceptions, however, most of them are competent cyclists in normal physical condition. The performances examined are indicative of the standards of physical effort which might be expected of any group of normal persons after reasonable preliminary training and preparation.

All the performances analysed were put up under normal 'working' conditions. In no case were they recorded experimentally or under controlled conditions; the possibility that investigations such as this might subsequently be based on them was never in the mind of anyone connected with the events. The times recorded represent, in the majority of cases, the best effort of which each rider was capable on each particular occasion. In cycling time trials the riders start at 1 min. intervals; they ride alone, and although they may pass or be passed by other competitors, they do not 'race' in the usual sense

term. They can have knowledge of the progress only of those of their rivals who start ctly before or shortly after them, and in consequence must make their best effort, ing that it will prove to be better than that of their rivals. The less speedy riders also e inducements to make their best endeavours. There is usually a handicap section, with cial prizes awarded on the basis of net times, arrived at by deducting from the actual es a predetermined handicap allowance arrived at by assessing earlier performances. ers also compete for awards offered by their own clubs, or seek to achieve a certain ndard, and among even the slowest riders there is a constant desire to improve upon ir previous best time for each distance. Hence at all levels riders are striving to achieve best performance of which they are capable. Occasionally a rider will encounter chanical trouble or delay through other causes, and unfortunately there is no detailed ord of such delays. These are not frequent enough to invalidate the general conclusions be drawn from analysis of the figures. Cases where delay does occur, or where riders any reason fail to achieve their best, are likely to affect the investigation only so far he slower times are concerned.

III. Collection of data

e events included in this investigation have been selected at random from the result ets available. They include first-class open events (in some of which the fields were cted from an entry in excess of the permitted maximum); second-class events with small ds; events open only to women riders, and one novice event, in which 19 of the 52 shers were riding their first trial. They include events at 25, 50 and 100 miles and 12 hr., d at various times in the years 1945 to 1950 inclusive. Also used in this investigation times recorded in connexion with the national 'all-rounder' competition based on formances at 50 and 100 miles and 12 hr.(2).

IV. Comparison of performances at different distances

e arithmetic means of 60 sets of performances at the three standard distances in the ional 'all-rounder' competition have been calculated. The performances included sist of the last 20 riders in the 1937 list of 161 riders; the last 20 in the 1938 list of 173, the last 20 in the 1939 list of 111. These give the following means:

50 miles	2 hr. 18 min. 43 sec.
100 miles	4 hr. 56 min. 59 sec.
12 hr.	220·8 miles

The times per mile for these performances correspond closely to the empirical curve

$$\text{hours per mile} = m + n \text{ distance}.$$

They are approximately 1·052 times the hours per mile of the means of 67 performances leading riders, found in the previous investigation(1). When the values 0·0376 for m 0·0009 for n found from the means of the 67 leading performances are multiplied by 52, the formula gives the following times:

50 miles	2 hr. 18 min. 45 sec.
100 miles	4 hr. 54 min. 8 sec.
12 hr.	223·5 miles.

These times suggest that the performances of the slower riders are approximately pro portional to those of the faster riders; such slight variation as there is indicates a relatively reduced standard by the slower riders at the longer distances.

V. Variation of speed during performances

In four of the 100 miles events included in the present investigation (Yorkshire Cycling Federation, 1945, 1946 and 1949, and Heavy Woollen District, 1950), intermediate times are available which permit an analysis of each rider's time for 50 miles. For purposes of comparison this time has been calculated as a percentage of the time taken by the rider for the full 100 miles. It is found that of the 170 riders whose times are available, 147 (86·5%) spent between 47 and 50% of their time on the first half of their task. These 147 riders have been divided into five equal groups, according to their final times. In group 1 (consisting of the fastest riders), very few spent less than 47% of their time on the first half of their task; one or two spent more than 50%. In group 5 (the slowest riders) 5·3% spent less than 47% of their time on the first half; none took 50%.

The figures given in Table 1 show a slight trend in the same direction throughout the groups:

Table 1. *Distribution of time spent on first half of task by riders of different speeds*

Total time spent on first half of task (%)	Group 1 (1st 20% fastest)	Group 2 (2nd 20%)	Group 3 (3rd 20%)	Group 4 (4th 20%)	Group 5 (5th 20%)	Total
			(Percentage of total riders concerned)			
<47	0·6	1·7	2·4	1·7	5·3	11·7
47–47·9	2·9	8·8	3·5	10·0	8·2	33·4
48–48·9	11·8	7·7	8·2	6·5	4·1	38·3
49–49·9	4·1	2·4	6·5	1·2	0·6	14·8
>50	1·2	—	—	0·6	—	1·8
						100·0

The arithmetic mean of the 170 performances examined above is 48·0%, and the average time 4·965 hr. In the original investigation (1) it was found that intermediate times in 12 hr. events were:

50 miles	2·395 hr.
100 miles	4·909 hr.

In the case of leading riders, therefore, the 50 miles time is 48·8% of the 100 miles time. The percentage of time spent on the first half is thus seen to be slightly higher on a slightly faster 100 miles.

VI. Distribution of capacity about the mean

An analysis has been made of the performances of 1323 finishers in 22 events listed a Table 2. The median time recorded in each event (that recorded by the rider finishing halfway down the list in time order) has been taken as a datum point, it having been checked that this usually varies only fractionally from the arithmetic mean time. The differences between the median and the remaining times have been calculated as a percentage of the median time, and classified in groups of from 1 to 9% faster and slower than the median. In each event the number in each group has been calculated as a percentage of the total number of riders finishing in the event. In this way it is possible to compare the proportion of riders who, in the different events, are within certain limits of the median times. The margin by which the winner's time was faster than the median time has been similarly

	y ⌐ ±9%	Winner's time faster than median by (%)	No. of finishers	Notes
Yorksh	99	5·6	74	38 surplus entries rejected
100 m				
Heavy	94	8·7	18	Entry restricted to local riders
100 m				
Yorksh	93	11·0	70	—
100 m				
Pennin	98	7·9	104	31 surplus entries rejected
Yorksh	98	9·1	62	—
12 hr.				
Morley	95	11·0	62	—
Pennin	95	8·9	106	18 surplus entries rejected
Pennin	94	8·0	74	23 surplus entries rejected
White	94	9·4	54	Women's National Championship Event
25 mil				
Spen V	96	11·5	82	—
Yorksh	96	10·0	80	—
100 m				
Yorksh	94	8·8	74	—
25 mil				
Yorksh	91	10·0	22	—
100 m				
Drighli	88	10·2	52	Substantially the same riders
Heavy	89	9·7	38	
50 mil				
Pennin	91	9·5	106	25 surplus entries rejected
Yorksh	93	7·9	52	Novice event; finishers included 19 men competing for the first time
Longr				
Yorksh	92	11·2	34	—
12 hr.				
White	75	9·1	16	—
25 mil				
Yorksh	88	8·3	55	—
100 m				
Morley	91	11·4	34	—
Bramle	86	12·0	54	—
Aggreg	94·1	9·5	1323	—
No. in	—	—	—	—

calculated as a percentage of the median. The results are shown in Table 2 (in which the aggregate figures have been arrived at by taking the sum of the actual number of performances in each category and calculating the percentage they represent of the total riders involved).

When plotted, the distribution of the faster performances appears to be regular and normal; the distribution of the slower performances is more erratic (probably due to delays of the kind mentioned earlier, p. 173), but it follows a similar general pattern (Fig. 1).

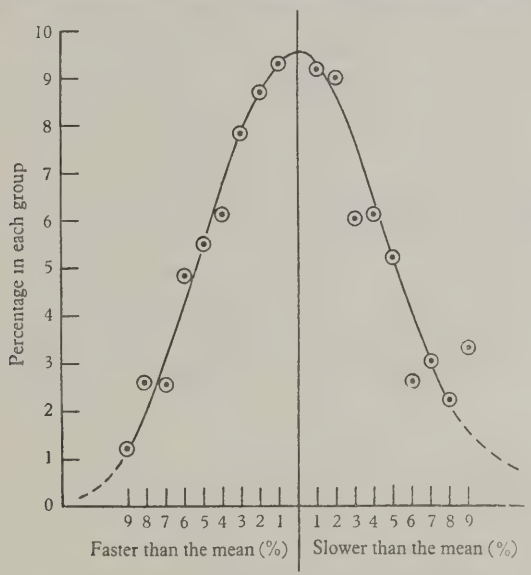

Fig. 1.

The distribution appears to suggest that in an average group, the fastest performer will be approximately 10% faster than the average; that the time of 75% of those taking part will be within ±5% of the average, with a further 12½% more than 15% slower than the fastest. In other words, of 1000 performers, the fastest of whom can complete a task in 54 min.,

approximately 125 will take from 54 to 57 min.
approximately 375 will take from 57 to 60 min.
approximately 375 will take from 60 to 63 min.
approximately 125 will take more than 63 min.
most of them taking less than 66 min.

The extent to which this apparently normal distribution can be varied by abnormal conditions is considerable.

Each year there is held an event at 100 miles (promoted by the Bath Road Club) which attracts probably the best entry of any event in the country; the selected riders include most of the country's fastest men, and few but first-class performers are accepted. In 1939 there were 64 finishers, all of them within ±7% of the mean. The distribution was:

	±1%	±2%	±3%	±4%	±5%	±6%	±7%
Percentage of finishers	25	53	67	78	89	95	100

Some years ago there was held an annual 50 miles event (promoted by the North Road Club), in which 12 riders adjudged to be the year's best performers at the distance were

invited to take part. In the 1928 event the difference between the fastest and the mean was 2·2% and between the mean and the slowest 2·7%. The distribution was:

	±1%	±2%	±3%
Percentage of finishers	58	83	100

Conversely, a 'veterans' 25 miles event was held in Yorkshire in 1947, in which all the participants were over 40 years of age. Some of them were still in first-class physical condition and in good cycling trim; others were not. Some were considerably older than 40 and of much reduced cycling capacity. The fastest rider was 15% faster than the mean the slowest was more than 15% slower. The distribution was:

	±1%	±2%	±3%	±4%	±5%	±6%	±7%	±8%	±9%	±10%	±11%
Percentage of finishers	0	0	19	19	19	19	31	31	31	50	56

	±12%	±13%	±14%	±15%
Percentage of finishers	69	81	81	94

Examination of the performances of 14 riders who finished in each of the three Pennine 25 miles events, in April 1949, and April and June 1950, shows that their variations from the mean fluctuated considerably in the different events. In one of the events, one rider was 4·9% faster than the mean of the 14 riders concerned; in the second event he was 0·7% faster; in the third 0·8% slower. Thus between his extremes there was a difference of 5·7%. The average of the extreme differences of these 14 riders was 2·5% of their mean.

VII. Conclusions

It appears that the relationship between the time taken to carry out a process and the number of times the process has to be repeated is similar for all classes of performers who have achieved a normal standard of proficiency, and that the slower performers will record times which are approximately proportional to those of the faster performers; any variation will be in the direction of a slight relative decrease in speed by less experienced performers when engaged on longer tasks.

It is found that the more experienced and more successful performers spend more of their time on the first half of their task, and less on the second, than the less experienced. They start relatively more slowly but finish faster, expending their energy more evenly over the whole of the task in hand.

It is seen that there is considerable variation—6 min./hr. in the general case, and up to 12 min./hr. in extreme cases—between the times which different individuals, making their best efforts, may take to achieve the same task, and that there may be up to 3 min./hr. variation in the times taken by the same individual to perform the same task on different occasions.

References

(1) Ward, N. (1950). Speed as a function of distance. *Brit. J. Psychol.* xl, no. 4, 212.
(2) *Cycling*, xciv, 27 October 1937; xcvi, 2 November 1938; and xcviii, 4 October 1939.

(*Manuscript received* 17 *October* 1950)

NOTE ON A 'NEW' NON-VERBAL INTELLIGENCE TEST ITEM

By A. DEANS PEGGS (*Colonial Education Service*)

I. Description of the item

the realm of intelligence test items there can now surely be nothing new under the sun. e item described here is 'new' only in so far as it has not been seen by the writer in y non-verbal test, British, Canadian, American or Australian, and was devised ntaneously in the course of research at the Education Research Unit[1], Jamaica. The rpose of this note is to describe it to others who may wish to experiment with it.

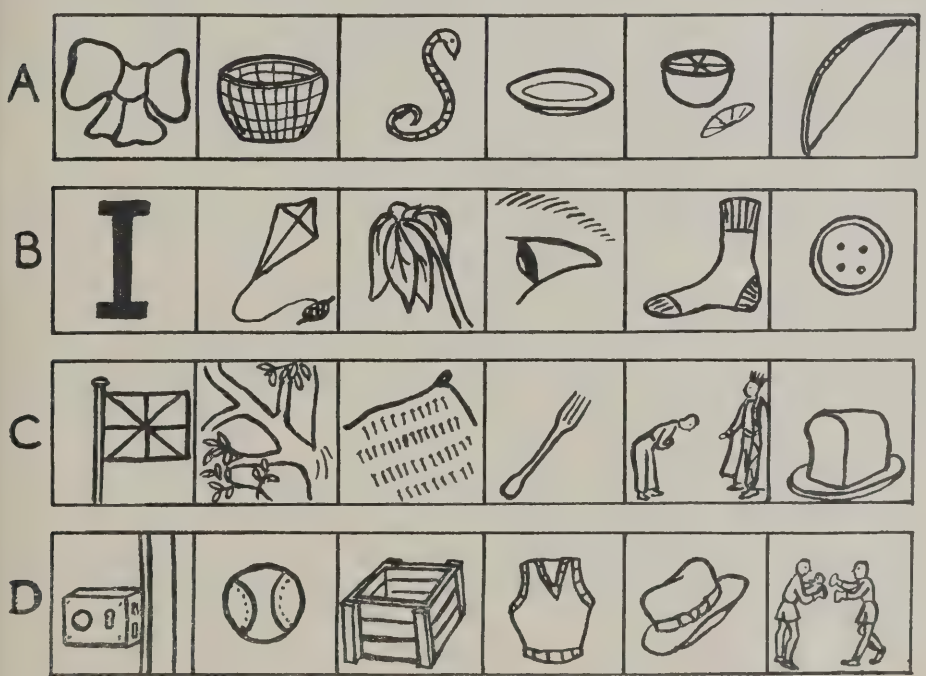

Fig. 1.

'Homonyms' is a convenient name as the aim in solving the item is to pick out two tures, from several, which portray either

(*a*) different meanings of the same word, or

(*b*) different words having the same pronunciation.

e words portrayed may be nouns or verbs. Other parts of speech do not lend themselves

[1] A temporary Unit pursuing research during 1947–50 under Colonial Development and Welfare Psychological Research Scheme R 93*c* under the auspices of the Colonial Social Science Research Council.

well to use in this item though adjectives have been tried. Verb tenses other than th present are difficult.

The execution of a drawing which will be recognizable for what it is intended to portra presents great difficulty as in most non-verbal items. This applies especially to verbs an adjectives but also to nouns where only a part of a whole object is implied. Thus, whe portraying the brake of a bicycle, it is necessary to compromise between drawing enoug of the bicycle to identify the brake and drawing so much of the bicycle as to detrac attention from the part to the whole. It is quite impossible to use many homonym because of the difficulty of portraying the words involved, e.g. 'weight' and 'wait'.

Examples are given in Fig. 1.

II. Results obtained in Jamaican experiments

264 Jamaican pupils, aged 11, in secondary and elementary schools were allowed to tr 28 of these items. In the instructions given orally, four examples were fully explaine and were followed by six practice items. For each item a facility (or difficulty) value, F and an efficiency (or item-validity) value, E_{13}, were calculated. F is simply the percentag of children 'passing' the item while E_{13} is the difference between the proportions passin in the top and bottom thirds. The children were allocated to thirds on the basis of tota score in this and fifteen other types of non-verbal items numbering, in all, 600.

The two items A and B illustrated above, each involving two nouns, had facility value 55 and 61 respectively with efficiency values of 0·69 and 0·75. The items, C and D, eac introducing a verb, were more difficult ($F = 19$ and 27 respectively) but one of them (D had a fairly high efficiency value of 0·65 whereas C had an efficiency value of only 0·3 In general, the items were much too difficult for the children concerned, only four of the being answered correctly by more than 50% of the pupils. Correspondingly, E_{13} exceede 0·50 in only seven instances. The fact that, in all items, the percentage of success increase uniformly from the bottom to the top third where, in most cases, it was fairly high suggest that the item may be more suitable with other groups such as secondary school pupi only or unselected children of greater age (in Jamaica).

To assess the extent of possible ambiguity, the pupils were required to write th homonymous words in addition to merely indicating the correct alternatives. This revealed a clear distinction between right and wrong responses as there was virtually no evidenc of justification of wrong responses. One notable exception, involving 'crown' (as wor by a monarch) and 'crown' (of a hat), produced 16% of responses 'hat—hat'. To insis that this response is not a homonym would be pedantic.

In a further experiment a total of 51 such items, together with 1153 other non-verba items in 18 tests and a battery of verbal tests of intelligence and attainment, wer administered to 522 pupils. Analysis of these results gives the following informatio about the homonyms:

(*a*) There is no significant sex difference.

(*b*) Product-moment correlations with nine other non-verbal tests involving 'concrete objects (animals, vehicles, buildings, etc.) varied within the narrow range 0·62–0·71.

(*c*) With nine non-verbal tests involving 'abstract' elements (lines, dots, square crosses, etc.) the correlations were 0·55–0·67.

(*d*) With total score in all non-verbal tests the correlation was 0·82.

(*e*) With score in two verbal intelligence tests of 100 and 50 items respectively the orrelations were 0·81 and 0·76.

(*f*) With score in two attainment tests in English and Arithmetic of 120 and 100 ems respectively the correlations were 0·81 and 0·73.

(*g*) With total score in the four tests of the verbal battery (including arithmetic) the orrelation was 0·82.

A factor analysis of the results of this experiment is being carried out.

(*Manuscript received* 4 *August* 1950)

CRITICAL NOTICE

By T. GRYGIER

THE PSYCHOLOGICAL PROBLEMS OF SOVIET RUSSIA

The People of Great Russia. A Psychological Study. By Geoffrey Gorer and John Rickman. London: The Cresset Press. 1949. Pp. viii+238. 10*s.* 6*d.*

Dictators and Disciples: From Caesar to Stalin. A Psychoanalytic Interpretation of History. By Gustav Bychowski. New York: Internat. Univ. Press. 1948. Pp. 264.

I. Introduction

Since the publication in this *Journal* of an article describing some of my observations in a psychiatric hospital in the Soviet Union during the last war(6), two important books have appeared: Geoffrey Gorer's and John Rickman's *The People of Great Russia*, and Gustav Bychowski's *Dictators and Disciples: from Caesar to Stalin*. Both these books deal with the psychological problems of Soviet Russia in much greater detail and more systematically than I have been able to do, and if I refer to my own article on the subject it is only because I propose to discuss these books in the light of my personal experience which was described in this *Journal*.

Gorer's and Rickman's book is entirely devoted to Russian psychology and will be discussed here in some detail, while Bychowski is concerned with dictatorship in general and his book will be referred to only in a supplementary way, as far as it deals with the Russians' attitude towards their leaders.

Gorer's and Rickman's book makes the following main points:

(i) that since the Czarist days there has been no great change in the factors affecting the character development in Russia;

(ii) that there is an essential difference between the psychology of the masses and that of the *élite*;

(iii) that one of the most important and unchanging factors is the habit of swaddling little children;

(iv) that this factor, combined with some others, produces the 'unfocused guilt' which is a national Russian trait, having many social and political implications.

Both books discuss:

(v) the relationship between the leaders and the led in Russia;

and Gorer puts forward

(vi) some political maxims indicating how to deal with the Russians and their leaders.

I shall deal with these points in the order described above.

II. The change of environment in Soviet Russia

Gorer makes the assumption that Russia is still a peasant country, and that 'the environment in which most Russian peasants live and work has probably changed very little in the thirty years since John Rickman was a country doctor among them'. Following that assumption he uses the present tense to describe the customs of the Great Russian peasants, although the greater part of his 'most concrete material dates back twenty years or more' (pp. 94–5).

I do not think that assumption is justified. First, Russia is not a peasant country to the extent she was thirty years ago. In the period 1926–39 alone, for which we have reliable data (7), the urban population of the U.S.S.R. *increased* by 112% while the rural population *decreased* by 5%. We know that the same trend had already appeared before 1926 and in all probability has been maintained after 1939. Secondly, the Russian farmers have become to a great extent industrialized: they have ceased to be peasants and become agricultural workers, engineers of the tractor stations, and officials of the State Farm and Kolkhoz system. Thirdly, in one particular respect to which Gorer and Rickman attach much importance, there has been a definite change, at least in some districts of Russia—according to what information I could gather swaddling of small children which was a rule some twenty years ago, has been abandoned not only in theory (which Gorer admits, p. 216) but in practice. I shall refer to that problem in more detail below.

Strangely enough, although I do not accept Gorer's assumption of a 'static condition' in Russia, and laim that Soviet children are brought up in a different environment from that of their parents, the nderlying *attitudes towards children* seem to have changed little, and that is perhaps the reason why agree with Gorer as to the Russian national characteristics, although I do not always agree with him as o the environmental factors and mechanisms which might have produced them.

III. The difference between the psychology of the masses and that of the *élite*

his hypothesis I tend to reject more in theory than in practice. In theory I do not think it is tenable: oviet Russia has not yet produced a hereditary *élite* having a system of upbringing and child care different rom that of the masses. The former *élite* has collapsed: the same person may belong to the masses, may ucceed and become a member of the *élite*, and may be found guilty of sabotage or lack of 'vigilance' and ecome an outcast. I know of no country in which circulation of the *élites* is faster and less predictable han in Soviet Russia. Thus the differences between the psychology of the masses and that of the *élite* an only be differences in attitudes which change with the movement up or down on the social scale. Gorer oints out, for instance, that the masses submit resignedly to firm authority imposed on them from above, hile the *élite* 'are haunted by fears that they will be in the position of complete subordination, complete eakness' (p. 190). While I agree with these statements I do not think they are incompatible in relation o any one person. The same person may fear weakness when he is in power, and accept it when his power as declined, and this is just one of the 'inconsistencies' of human nature in general and Russian national haracter in particular.

IV. The swaddling hypothesis

Gorer and Rickman say that in Russia 'from the day of its birth onwards the baby is tightly swaddled n long strips of material, holding its legs straight and its arms down by its sides' (pp. 97–8). 'The usual nethod of swaddling is very impersonal' (p. 99). The Russians explain that 'the baby is potentially so trong that if it were not swaddled it would risk destroying itself or doing itself irreparable harm, and ould be impossible to handle' (p. 98). The writers suggest that swaddling is painful and the infant esponds to it with rage, which is projected and produces guilt or fear (p. 215). Thus swaddling is the main actor producing the 'diffuse guilt reaction' (p. 224), which is in turn one of the most important Russian haracteristics.

Here again I agree that Russians have specific guilt reactions, but not that this is produced by the Russian method of swaddling.

First, children were swaddled in other European countries than Russia, in particular in Poland. The nethod was similar, but the explanation given by the mothers was different. As pointed out by Benedict(1) n Poland 'the infant is regarded not as violent, but as exceedingly fragile'. There, in contrast to Russia, ersonal and intimate relationships were maintained between mother and child. Thus the same system f child-rearing was symptomatic of a totally different attitude towards the child and this may help to xplain the difference between the Russian and the Polish national characters.

Secondly, swaddling seems to have largely disappeared in both Poland and Russia, although the ttitudes 'explaining' its necessity remained relatively unchanged. In particular, I received some in- ormation from my mother, the late Dr Halina Grygier, who had worked as a pediatrician in Northern Russia during the last war, as well as periodically in Poland between the wars (1918–39). In Russia she vorked for several years in an Infants' Clinic, and it was her duty to visit all newborn children in a district vhich was partly urban partly rural in character. Since it was her second visit to Russia, she was aware f the general practice of swaddling and the explanation given by the mothers in John Rickman's time, ut she found this practice completely extinct in 1940–2. Similarly, in Poland, she had found swaddling ommon after the 1914–18 war, the usual explanation being that the child is too weak and might 'break', ut fairly rare before the 1939 war, although Polish children were still regarded as weak and in need of rotection, while Russian children were held as strong and dangerous to themselves and others.

If swaddling itself were important, its disappearance might lead to the change of national character. f, however, it is only a symptom of the total system of attitudes and values of the protective or impersonal tmosphere of the household, its disappearance may produce no psychological effects. In places Gorer imself expresses this view: 'Swaddling is one of the devices which Russian adults employ to communicate vith the child in its first year of life, to lay the foundation for those habits and attitudes which will ubsequently be developed and strengthened by all the major institutions in Great Russian society'. The thread is not the labyrinth'—admits Gorer (p. 129)—'but it is psychologically almost impossible or the explorer, who has relied on a thread, not to over-emphasise its importance.'

V. Other factors

The 'swaddling hypothesis' leads to some other factors responsible for the Russian character structure, and Gorer singles out the alternation of complete restraint and complete gratification as the first one to be acting on the child. As Russian swaddling represents restraint, so the daily time of unswaddling, suckling and petting represents gratification. They alternate, according to Gorer, for the first nine months of life, and their influence is strengthened in later life. Thus Russian workers are either considered healthy and capable of hard work, or they are ill, nearing death and incapable of any effort. They are given plenty of food or are put on a starvation régime. In morality, in politics—and, I should add, in science—'you are in the truth or else you are outside it, you "belong" or you don't' (p. 232)—and so you are treated accordingly as a good citizen or as a criminal and a traitor.

Combined with the alternation of gratification and restraint is the factor of multiplicity of authorities. Gorer and Rickman justly point out that the relationships between the parents and the child are rather impersonal, that the child is brought up by three generations simultaneously, and that the influence of the 'nyanya', a woman distant from the parents in age or caste or both, is greater than that of the mother. I should add that the 'nyanya'—in John Rickman's time, usually an old woman charged with the child's upbringing—seems to be no longer old. Particularly in towns, but even in rural districts, it is now usually a girl of 10–13 years, taking care of the younger children when the mother is working. Thus the authority which the child is supposed to incorporate is both immature and unpredictable.

The development of nurseries, shortly before and during the war, must have also contributed to the multiplicity of authorities which the child encounters in its first years of life. Their effect could not for obvious reasons be examined by Gorer and Rickman, but it would certainly add to their evidence. The development of the system of 'communal living' ('obshchezhitye'), whereby several families are allocated one house, with a complicated internal organization in which almost everybody is in some respect in the power of everybody else, adds to the unending muddle of responsibilities. When everyone tries to assume power over all in the house, children and adults alike, all being at the same time afraid that they might be accused of some politically dangerous attitudes or actions, there seems to be no final authority to look to as a safe guide to behaviour. Thus the developments I was able to notice during the war merely accentuated the observation by Gorer of the depreciation of the concept of conscience and 'the low potential of internalized ethical parental figures' (p. 147).

VI. The diffused guilt

The principle of diffused authority, together with the Russian method of swaddling and the alternation between complete restraint and complete gratification, lead, according to Gorer and Rickman, to the fact that 'the majority of Great Russians have a diffuse feeling of guilt, which is largely or entirely unconscious, and a diffuse feeling of fear, derived from the projection of their infantile hostility' (p. 194). This diffuse feeling of guilt expresses itself in the Russian custom of 'un-guilting' (the Russian word 'pokayanye' denotes complete self-humiliation and submission in order to atone for the misdeeds), in the specific atmosphere of State Trials in which the accused join the prosecution condemning themselves in strongest terms, and in the fact noted even at the end of the nineteenth century that in Russia 'a person arrested on suspicion, even though there be no legal proofs of guilt, and no likelihood of their ever being obtained, will take the Juge d'Instruction into his confidence and glibly relate every detail of his share in the transaction' (p. 130).

In my personal experience in Russia I lived through an incident which might also illustrate this point. On one occasion I was arrested and accused of having stolen the sum of 8100 roubles, the property of the local State Shop. During the tiresome investigation, conducted practically without interruption by day and night, nothing seemed to have been done to establish the facts and the circumstances of the alleged theft, and the whole procedure consisted of increasing pressure and threats to get my confession. The initial charge of theft was expanded considerably—it was now assumed that I must have had accomplices and I was told that they had already confessed. It was also assumed that I should not have wanted such a large sum of money if I did not plan to leave my place of work and thus to sabotage the common effort of building up the Socialist State.

This became so serious that I adopted a philosophical attitude as the only way of dealing with so impossible a situation. In this philosophic mood I recalled the maxim 'omnis cellula e cellula' and speculated that in a similar way every difference should be the outcome of another difference. The most obvious difference the missing sum of 8100 roubles could have come from would be if we inserted 9000 instead of 900. That could have easily happened if the local accountant mistook the row in his calculator.

us the sum of 8100 roubles might not have been stolen at all, neither by myself nor by anybody else—was only a mathematical error.

My explanation was, of course, rejected as a complete nonsense and the pressure continued, but I insisted checking the accounts and finally proved to be in the right: no money had been stolen, all there was s the accountant too tired to deal properly with his sums. I was duly released and had a pleasant talk th my prosecutor. 'What I cannot understand'—he admitted in a friendly mood—'is why you did not nfess. With all that evidence we had! With the charge of sabotage against you! I have never seen a man o would not have confessed to everything in the circumstances.' It was clear from what he said that e young prosecutor had had no experience with non-Russians.

VII. The external conscience

much as I agree with the descriptions of the various phenomena of 'un-guilting' and self-accusations, ambivalence and oscillation between different moods and types of behaviour, I am sceptical about the ncept of 'diffuse guilt' by which Gorer and Rickman seek to explain them. I have developed instead oncept of 'external conscience' which seems to me to offer a better explanation of these phenomena, well as to embrace some others for which the 'diffuse guilt' concept would be inadequate.

The concept of 'external conscience' differs in some respects from that of 'authoritarian character', veloped by Fromm, the essence of which is 'the simultaneous presence of sadistic and masochistic ves'(4), while the authoritarian conscience is 'the external authority internalised'(5). To my mind the ssian child does not encounter in its life any stable external authority which might be adequately ernalized, nor a definite set of rules which may be a safe guide of behaviour. The family bonds are weak, e father and the mother are just adults, not more powerful, nor much more if at all loving than any ers of the great variety of people who exert influence on the child. Thus 'good' or 'true' is not what the ther says or the child discovers by itself, but what any powerful person present considers good or true. s not safe to think for oneself—it is better to follow.[1] Guilt is the unpleasant feeling that you annoyed owerful person and you may have to pay for it. If you submit without questioning you will decrease tension of this guilt.

The underdevelopment of the independent agencies of judgement and conduct within the personality y also offer some explanation of the oscillation between complete identification and non-identification. e Russians, like children, do not do things by halves—having no integrated source of judgement they n only totally accept or totally reject both facts and values. 'If you are my enemy I can cheat you d lie to you'—quotes Gorer (p. 155). If you did not tell the truth on one occasion, you are a liar, and u never told any truth in your life. If you have done something against the interest of your country, u are a traitor and you have always been a traitor. Even Russian children must learn (again quoted by rer from a Soviet text-book, p. 164) 'not only to hate the enemy, but also to struggle with him, in time unmask him, and finally, if he does not surrender, to destroy him'.

From the Western point of view, sudden changes from love to hate, from one belief to another, are rely cynicism—the Russians, we say, only believe in what is good for them at the moment, will never ep their word, and will declare one thing to-day to do something else to-morrow.

To the Russian it is *we* who are dishonest. There cannot be a better example of hypocrisy and cynicism an the English understatement and the tendency to regard everything from two points of view. Only e point of view can be 'true' and 'right': if you claim otherwise you are a cheat.

[1] The necessity of avoiding individual judgements and of following the party line and the 'collective conscience' well reflected in the following official statements. One is by B. S. Mankovski, the principal speaker at the eting of the Department of the Theory of State and Law at the Academy of Social Sciences of the Central mmittee of the Soviet Communist Party. In his lecture, entitled: 'Vladimir Yilich Lenin and the party aracter of science' (8) he underlined the necessity for strict communist approach to scientific matters and the plication of law.

The other statement is by Mr Vyshinski(9). He gives the following principles of Soviet justice:(1) 'The bonds ning court and prosecutor's office are of the closest possible character and they are united by an indissoluble d organic bond. Their tasks are identical although they employ different methods of work' (p. 498). (2) 'Dis-nsing justice is one of the state's most important functions. In the socialist state it consists in resolving matters, nsferred to be considered by the court, on the basis of Soviet laws and the socialist legal consciousness of the lges....' (p. 499).

Both these statements mean that the 'socialist', i.e. external and collective, conscience should be applied.

VIII. The Russian attitude towards the leader

The 'external conscience' and the oscillation between complete identification and non-identification express themselves, among others, in the attitudes towards the leader. When there is no internal guide of behaviour, there must be a powerful external authority. A rejection of one external authority must be followed by the acceptance of a new one—the development of the internal authority is too complicated a process to give immediate results. Besides, there are no elements in the Russian primary group system which could be adequately incorporated and integrated.

Rickman and Bychowski describe in some detail the almost religious character of the attitude of the Russian masses towards their leaders. My own evidence(6) indicates that this attitude is so deeply rooted that it expresses itself even in the delusions and hallucinations of the psychotics, and in the characteristic devotion to the Marxist-Leninist doctrine in the younger generation of the epileptics. We all agree that in the present-day Russian society this extreme idealization of the leader is a psychological necessity. We differ only in the explanation of this phenomenon: what I tend to explain by the external character of the conscience, Gorer ascribes to 'the all-pervasive unconscious hostility and guilt' engendered in infancy, and Bychowski to the primitive psycho-cultural pattern which he analyses on the lines indicated in Freud's *Totem and Taboo*(3). Strangely enough, it is Bychowski who offers the psycho-analytic interpretation of the Russian reaction towards the abdication of the Czar described by Rickman. Much as I like my own pet theory of Russian psychology I must admit that Bychowski throws more light on that particular point.

IX. The political maxims

It is impossible to discuss here all the political maxims put forward by Gorer. Their exposition is so concise and lucid that any attempt at a summary would end in failure; I am so much in agreement with them that I only wish they were adopted by the politicians. I would only add to Gorer's ten commandments one which is not expressed but is perhaps implied by him: that it would be futile to expect help from any appreciable number of 'good Russians'.

When we refer to 'goodness' we refer to nothing else but our system of values and our type of conscience. 'Moral action is action in accordance with values'—says Flugel(2). There are no values outside a cultural context and Russian culture has produced a different system of values from that developed in the West. There is no conscience of the type guiding all integrated men and women in the Western society without the incorporation into their minds of the more or less coherent systems of moral attitudes of their parents or parental substitutes. The evidence offered by Gorer, as well as my own observations, tend to show that the Russian child has no opportunity for such incorporation. Even if it had, the moral attitudes would be different. Thus there will be no 'good Russians' in our sense before the whole pattern of the influences acting on the Russian child changes and becomes like ours. That will probably take some generations of social evolution. For the time being, having no ally in the conscience of the Russian people, we shall have to adopt 'the only type of political behaviour which will contain Russian expansion: firmness, strength, consistency'. 'And the greatest of these is consistency'—says Gorer.

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CRITICAL NOTICE

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Traité de Logique—Essai de Logistique Opératoire. By Jean Piaget. Paris: Librairie Armand Collin. 1949. Pp. viii + 423. 1,400 fr.

Students of psychology who are not also amateurs of mathematical logic should perhaps be warned that, on the surface, this is not a book for them. As the sub-title makes clear, it takes a strictly formal view of logic, which it sees as identical with logistics (= logical *calculus*). Logic is indeed regarded as a complementary counterpart to a section of psychology (or psycho-sociology); but this very fact involves their being kept distinct and apart. The former represents a self-contained, refined or purified model of the operations of thought which the latter studies in their living context. There is thus no room for overlap or mutual encroachments. And once the ground has been cleared, Prof. Piaget proceeds in the main chapters of his treatise first to build up systematically the symbolic calculus of intra- and inter-propositional operations; then, to analyse and discuss the formal foundations and axiomatics of logic; and finally to consider more fully that most difficult and crucial problem for all modern logisticians, the relation between logic and mathematics.

Professional logicians will without doubt do justice both to the very great interest and value of his fresh all-round approach, and to his stimulating treatment of the chief individual logistic themes. For such justice, however, or even for any detailed presentation of Piaget's more technical views, this *Journal* is hardly the place. Nevertheless, there are aspects of the treatise and recurrent discussions in it which merit the closest attention from any psychologist who is interested in a *whole* view of his field. It comes from the outstanding genetic psychologist of our time, and does *not* represent a mere adventitious interest on his part in another branch of knowledge (as if he had written about archaeology or numismatics). It expresses his view of the place which logic should rightly occupy in the psychological scheme of things and it is indeed presented as the proper rounding off and consummation of his thirty years' work in genetic psychology. The treatise should in fact be read in close conjunction with his recent monumental *Introduction à l'Epistémologie Génétique* (three volumes) and his *Psychology of Intelligence* (just published in English—Routledge, 1950). The latter is itself a brief summary of the outcome of Piaget's great sequence of detailed experimental studies of the development of all the various intellectual functions and processes in the child. This sequence culminates in a particular conception of the psychological nature and function of intelligence, which then in turn points for him, as its necessary complement, to just that strictly formalistic but nevertheless *operational* conception of logic which his Treatise seeks to carry through.

The psychological student should therefore be highly interested to take note of the broad picture of logic, as the formal counterpart and virtually the *theory* of the functioning of intelligence, which Piaget offers. Notwithstanding all its formal symbolism it is definitely a psychologist's and moreover a genetic psychologist's picture, firmly linked with the world of psychological facts which all his own work has brought to light. Logic is 'the formal theory of deductive operations'. These are all the operations which are necessary and sufficient to make deduction possible, and by which we can pass from true to true propositions or, more precisely, by which we can pass from any set or combination of true and false propositions to any others of which the truth or falsity validly follow from these. Such operations form integrated whole structures, of which the most fundamental characteristic is that of reversibility. The latter is, in fact, 'the most profound and the most general criterion of rationality'. Operations themselves are 'reversible transformations'. The psychology of thought or of intelligence (which Piaget treats as more or less synonymous) shows how these operations develop by progressive stages from actions which have become internalized and which can be followed through each stage from the earliest sensori-motor level. In the course of the child's growth these internalized actions can be seen to attain a continually greater degree of differentiation and organization, mobility and combinability, until the full operational level is reached and complete reversibility, with everything that this carries with it, is achieved. That is the level of intelligence proper when the child can effectively manipulate formal logical relations, that is, can freely 'add' them together and 'multiply' them with one another, link and unlink them, substitute and invert them, and in general exploit all their formal possibilities. Logic is the theory of these possibilities and intelligence their practice.

So much for the nexus between logic and intelligence, and the genetic psychologist's approach to the first. This is continually re-emphasized. The starting-point of every logical operation is an *action* of the subject consisting in bringing things together or placing them in some sort of order. Thus propositions, which express such actions, are anterior to classes and relations, as judgements are anterior to the concepts they engender and actions in general to their results. (That is a psychological thesis which is fundamental for Piaget's logical views.) Logic works out the calculus of classes, relations and propositions, but finds that each of these reproduces the same operational structures and is isomorphous with the others. Classes and relations are themselves functionally correlative: the former correspond to the extension, the latter to the comprehension or intention of concepts, which are in turn, as just noted, derivative from judgements, or, logically speaking, propositions. All the formal or logical properties of propositional systems have their counterpart and indeed foundation in logical operations, which again in the last analysis are psychological actions.

That is, broadly speaking, the scheme on which Piaget's logic is built. However, the picture so far seems more complete than in fact it is. We appear to be dealing here with the foundations of every possible calculus, including that of mathematics. That, by and large, would seem to be Piaget's own main position. But in truth, after his first general approach, he limits his treatise on logic to the detailed development of a calculus which by hypothesis is *not* that of mathematics. He now uses the term logic in contradistinction to mathematics and regards the two disciplines as having a certain amount of common ground, but also each beyond this its own separate field (though he does not rule out that they may sometime be fused in a single comprehensive theory of all formal thought). Meanwhile, however, he treats logic as specifically concerned with the more elementary level of operation, essentially that of intensive (as against extensive) quantities and above all that of part-whole relations and hierarchic qualitative class inclusions (e.g. those of zoological or botanical schemes of classification). These form the main basis for what he emphasizes as the key-notion for logic or logistics (in this narrower sense), viz. that of 'groupings'. This is a type of structure intermediate between mathematical 'groups' and 'lattices', and provides its own distinctive sets of properties, on which in fact Piaget's logistical calculus is based. However, he himself seems ready to describe this system of elementary operations as *pre-mathematical*, and there is much in his whole approach to suggest that he regards it as having only a very restricted scope and, for all the great apparatus he builds up, ranking merely as an entrance-hall or antechamber to the true final dwelling-place of intelligence and logic, which is mathematics.

The foregoing may serve (if I have understood Prof. Piaget correctly) to give a general idea, even though a very inadequate one, of the standpoint and compass of his important book. Since it presents a logic built on genetic-psychological premises, however far it eventually extends beyond their scope, it has, over and above its other merits, the signal one of compelling psychologists to *think about* the problem of the relation of psychology and logic. It should no longer be possible now for anyone concerned with the intellectual processes to brush this problem on one side as not really a psychologist's affair. That is a level of non-understanding and lack of *psychological* grasp which, thanks to Piaget, can now be left behind. Whether, however, we can accept his solution as a fully satisfactory one seems to me a more uncertain question. Obviously, any doubts which one may entertain must—as the very result of his work—apply to his conception of intelligence just as much as to his interpretation of logic. Taking the two together now, is the ground really covered? If, as a student of psychology, one contemplates the immense range and variety of the problems, the operations and the achievements which we should all regard as the work of intelligence, can one feel that the mere ability to manipulate the circumscribed apparatus of formal deductive operations embraces the whole essence and secret of them? The admittedly elementary complex of class-inclusion or part-whole relations surely does not: but do even this and mathematics together?

No detailed critique is possible here, but the following questions may be suggested.

(1) Does a formal logistical calculus, whatever its scope and potency, constitute a sufficient and satisfactory *logic*? Logicians can, of course, define as they please what they agree to present as their subject; but a psychologist with a sense of psychological history and reality is rather more bound down. It is rather as if, in the wider biological field, the name 'anatomy' were to be limited by definition to the science of vertebrate structure. We might thus get a particularly close-knit and homogeneous body of knowledge; yet every biologist would be aware that something more important was being lost. We should still need a place and a name for the larger and more fundamental science of the structures of *all* living things; and moreover this science would still have to include within its ambit that of vertebrate forms themselves, and work out their place and relations among the rest. In just that sort of way, Piaget's own treatise falls into two parts, of which only one is the actual calculus, and the other an examination of its foundations, together with a comparison of these with the foundations of mathematics. Many of us would

l that it is this inescapable examination of foundations that is the true basic logic, not any calculus
ıether of 'groupings', 'groups' or 'lattices'). The latter so clearly is only one particular scheme, among
ers, of *applied logic*.

2) What is the real value and scope of the particular calculus—centering on 'groupings'—offered by
get as the true content of logic? He seems himself to be in two or even three minds about this. Not
y does his own logic, as we have seen, go beyond any calculus, but his particular one is definitely
arated from that of mathematics, which yet comes surely also under his own formal definition of logic.
reover, he himself contrasts the elementariness and the limitations of his logistical calculus with the
undity and power of the mathematical one. No one can doubt indeed that it stands for something quite
ential (and a condition for everything else) *as far as it goes*. But just how far, *by itself*, does it go?
may note that practically all his own detailed instances of inferences which exemplify it are of an
ious and trivial kind. For the purposes of quick illustration, they might well be the best suited; but
the other hand they are also just what one might expect from the limitations of the underlying relation-
eme. And in the absence of any really impressive examples, what is the evidence that this calculus is
ficient for the more complex and difficult performances of intelligence, even outside mathematics?
d still more for all their diversity? Can it be shown as illuminating the handling of unobvious problems,
ever leading, by itself, to remote and unexpected results? All this is no doubt outside the ambit of
ıere calculus-logic concerned only to proceed from given definitions and rules to the demonstration
heir consequences. However, does that not again indicate that this sort of specific calculus-logic is not
real thing which we want? Once more we are led rather to a logic such as Piaget himself resorts to
practice, one that analyses and assesses, compares and discusses—but does so far beyond the limits
ich Piaget's formalistic assumptions impose on him.

3) If in fact we look more closely, as psychologists, at the calculus itself, are there not a lot more
estions which we want to ask about its own foundations? Are we really clear about the psychological
anings of all those elementary key-notions which it so largely takes for granted? Should anyone with
ense of the complicated psychological realities (and histories) behind such notions as 'and', 'or', 'not,'
uals' be willing to accept these as having a value that is unambiguous and self-evident? The same
plies to the notions of 'proposition' as such; of 'tautology' as used by logicians; the central concept of
plication'; and even those fundamental directive ideas of 'truth', 'not-truth' and 'validity'. It is
too-easy to point to multiple ambiguities and difficulties in each of them, and most logicians do find
ıecessary to discuss at least some of them. But usually not from a psychological point of view, which is
regarded as relevant. Yet it is just Prof. Piaget who might be expected to agree that, in some sense,
sychological understanding and grasp of the complexities involved (take, for instance, all the variations
meaning and inflexion of 'or') is relevant. A close psychological analysis and clarification does not of
ırse fit into the frame-work of a calculus presented as a self-sufficient deductive system; yet once more,
ts capacity of *clarification* this analysis is surely so necessary to the very meaning as well as the validity
the calculus, that it *demands* a conception of logic broad enough to leave room for it.

4) From another angle, if we look at the boundaries of the calculus as Piaget himself draws them, does
ıot at once become plain that there are whole realms of the inferential application of intelligence which
eaves out? Where and how are these to be dealt with, if not by a wider logic? Why do they less merit
lusion in its canon than that particular calculus, with its acknowledged elementary character and
itations? It is worked out only in terms of a 'bivalent' logic, which recognizes nothing but the two
ues of truth and not-truth and places itself under the complete dominion of the Principle of Excluded
ddle. But the first of these restrictions rules out all the vast field of uncertainty and probability,
oblematic truth and speculation, assessments of evidence and attempts to reach the most likely conclusions
balance, etc. And the second shuts out all the world in which the Principle of Excluded Middle is not
plicable and (owing to its traditional over-valuation) acts only as a pitfall and snare: all the world of
grees and intermediate states and cases, mixtures and fusions, fluctuations and changes. (Mathematics
leed takes care of some of these, provided certain conditions are fulfilled; but for lack of this most of
em still remain outside its reach.) In every one of these realms intelligence is constantly called upon to
ason and infer and decide, and there are vast differences between better and worse, more and less cogent
d successful performances; differences which can be studied and analysed and at least in some measure
dified as branches of logic in their own right. By comparison with their ambit, that of Piaget's calculus
tricted to formally valid, necessary deduction of the Excluded-Middle type represents only the smallest
ctor of our thought. And if we start from his own psychologists' postulate by which the actual level
operations of our most developed intelligence should define the field of our logic, this seems to leave
st reason for the excessively narrow circumscription of that field which his calculus implies.

It may be that Piaget's main answer to the foregoing would be that it mostly concerns the psycholo of thought, which he acknowledges, and not logic = logistics, as for various good reasons he still prefers define it. But even if this were to be conceded, such a psychology would have to be very different fro *his* 'psychology of intelligence', which is simply the reciprocal of his formal calculus-logic. And a ve different end-picture, embracing the calculus-logic itself, would emerge. There would no longer be a sing sharp division; the psychology of thought would pass continuously into a wider logic, of which the calculu scheme could only form a part. This might well remain a self-contained one, and its value and importan within its limits need not be underestimated. However, a logic of probability and of Included Midd would have an at least equal pride of place; and so would surely one of scientific method, or methodolog which Piaget dismisses at an early stage as having no part in logic at all and being a matter solely f the practitioners of the individual sciences. The general scheme would no doubt be more like that earlier days when a less zealous and exclusive logistics was content to form part of a larger whole; but t great difference would lie precisely in its new-found continuity with psychology; that is, in the existen of a transitional zone which could indifferently be called psychological logic, or psycho-logic, or t 'psychology of normative facts' (i.e. normative *psychological* facts = concepts and principles) in Piage own phrase. This intermediate science would be concerned with the *psychological foundations* both of t deductive (pre-mathematical) calculus and of mathematics, and would thus bring out the elements comm to the two. But it would equally be concerned with the psychological foundations of every other type inferential reasoning, or rules and procedures of intelligence, and their relations to mathematics and pu non-mathematical deduction as well as to one another. Nor could the complex psychology and logic of t universal instrument of all thought, viz. language, be left out of account.

Such a psycho-logic would thus cover all the ground which Prof. Piaget's scheme not only seems leave undealt with, but by implication appears to thrust outside all psychological or scientific regar Yet the root of the matter is there in him, in the unique genetic-psychological approach which he exceptionally combines with the necessary logico-mathematical competence. If he were not self-exclud by his present over-narrow definitions of intelligence and logic, he might well be ideally placed to provi both the psychology basic to a complete logic and the logic corresponding to a complete psycholog Perhaps he may yet be persuaded thus to amplify and complete his work.

PUBLICATIONS RECENTLY RECEIVED

Psychological Factors of Peace and War. Ed. T. H. Pear. London: Hutchinson (for United Nations Association). 1950. Pp. 262. 6*s*. net.

This contains essays by nine different contributors whose approach to the title theme is so varied that some comment must be made on each before any general assessment of the book can be attempted.

(1) Prof. T. H. Pear, as editor, introduces the volume and follows on with a discussion of 'Peace, War, and Culture Patterns'. His main thesis is expressed in the last sentence; 'upon one thing students of culture patterns are agreed: modern warfare is not due to simple instincts, nor is it inevitable' and he is concerned with the means by which this culture pattern (and those presumably of other potentially hostile nations) may be altered. Amongst other things the skilful use of press and radio are considered as valuable means to this end.

(2) Dr H. J. Eysenck gives an interesting resumé of recent work on war-mindedness, aggression, and war stereotypes, and concludes by stressing the need of further studies into (*a*) the correlates of war-mindedness, (*b*) the genesis of war-mindedness, (*c*) the relationship between social attitudes and personality traits, and he makes a plea for social scientists to have access to wider fields of research.

(3) Dr Madeleine Kerr, in a short paper, discusses two questions: (*a*) What is there in the psychological make-up of individuals which allows or forces them to acquiesce in their own destruction through war? (*b*) How do people make the adjustment of personality which enables them to cope with the changed social relationships of war conditions? In answer she suggests that personality is a pattern which changes in accordance with social circumstances and that an increased knowledge of these facts may enable us to control aggression.

(4) Prof. John Cohen mentions various physical and mental differences between men and women which lead us to believe that the more civilized the community the greater the discrepancy between the sexes, the more inferior, particularly in a Christian world, the status of women and the more war-like their character. He believes that the reversal of some of these tendencies through feminine emancipation may eventually lead to the emergence of a new social structure which is not wholly man made and possibly less aggressive.

(5) Prof. J. C. Flugel in considering 'Neglected Aspects of World Integration', discusses moral, political, and psychological methods of integration. He suggests that the psychological approach could be based on humanity's common struggle with nature and that this, either in the larger sense or in the smaller, i.e. conflicts in the soul of individual man, is compatible with the teaching of all great moral leaders.

(6) Prof. A. W. Alport, in discussing 'Research in International Co-operation', believes that world government is bound to come, but whether it comes easily or painfully and whether it is to be tyrannical or co-operative, may depend in part on the extent to which social scientists are listened to and on their ability to stress the most cogent problems. He lists ten main topics for investigation.

(7) Dr Hilde Himmelweit, quoting forty-two sources, makes an examination of studies of frustration and aggression, stating in conclusion that 'whenever a restriction has to be imposed the psychological ill effects (i.e. the possible aggressions) of such experience can be reduced by imposing it in a friendly environment, in an atmosphere of psychological security'. She admits also that this belief has always been recognized by good teachers and leaders.

(8) Dr H. V. Dicks makes a further contribution to his interesting writings on German character structure.

(9) Dr F. L. Richardson contributes two articles. The first, on 'Threats and Security', shows an interesting use of statistical method in analysing the impact on one state of the armed strength of another and the fatal mutual stimulation created by the belief that 'si pacem vis para sellum'. The second is on 'The Statistics of Deadly Quarrels'. Though interesting and erudite these two final articles can only by a long stretch of the imagination be considered as remotely psychological in content.

This bald synopsis may suggest the scope of the volume and the interest and importance of the several articles. However, the value of the book as a whole has to be assessed in different terms. It has been compiled for the United Nations Association because, since 'wars begin in the minds of men', psychologists should at least play some part in securing and maintaining peace. Hardly anybody could fail to agree with this, although many would claim that what is needed is less for a group of psychologists to work together than for them to co-operate with economists, sociologists, historians, and others who see different but equally vital aspects of the problem of armed conflict. But in conceding that the psychologist has a considerable contribution to make, we have to consider how it can best be put over.

The present volume seems, from its somewhat austere and in parts highly technical matter, to be aimed in fact, though not wholly by intention, at the sort of people who in any case read psychological books. I this is so, it is probably a sermon to an audience already largely converted. If, on the other hand, it is aimed at those who think of war solely in terms of economics or of 'human nature', it lacks the necessary directness, cogency, and unified focus. In addition, though there is much in it of value to the professiona psychologist, the articles on the whole are too short and in some cases too simplified to rank as important original contributions.

The book, in fact, falls between several stools. This is no criticism of the several authors or of Prof. Pea who has performed a useful service in bringing to public notice the fact that psychologists have something to say about war. However, its relative failure to meet a real need presents us with further problems fo study. The first, which indeed is suggested by various of the writers, is to intensify and to correlate work o war-mindedness and similar topics. The second is to discover the most effective way of putting the result forward.

ADAM CURL

Theory of Hearing. By E. G. Wever. New York: Wiley and Sons; London: Chapman an Hall, 1949. Pp. xii + 484. 48*s*. net.

Some psychologists find the task of keeping up with recent developments in the theory of hearing a some what imposing and not always rewarding one. To these especially the names of Wever and Bray afford a outstanding landmark as the discoverers of an effect which was the starting-point of so much fruitfu research in the last twenty years. Now Prof. Wever has written an extensive account of those very centra parts of the physiology and psychology of hearing which are particularly the outcome of his pioneer work Specialists and others will be much in his debt for a lucid discussion of the achievements of the past and th many difficulties which still remain.

Wever devotes the first part of his book to a fascinating and valuable presentation of the theories o hearing generally, and of cochlear function in particular, which were current prior to 1930. The grea authority of Helmholtz, and a considerable though incomplete body of evidence, convinced many of th general truth of a theory according to which frequency analysis of incoming sound was effected in th cochlea, although the invocation of resonance as the means by which this was done was not universall accepted. Nevertheless, a rival type of theory, which represented the ear simply as a device which merel converted sound vibrations into nerve impulses of the same frequency, and left it to the central nervou system to effect the necessary frequency analysis, was not disregarded. To Wever and Bray belongs th credit of bringing modern electronic resources to bear in direct experiment upon this problem. An although their apparently crucial experiment did not resolve a question whose complexity was far greate than had been expected, it introduced fresh factors of the greatest importance. The first of these was th discovery of bio-electric potentials in the cochlea, of non-nervous origin, which faithfully follow th incoming sound vibrations over a very wide range of frequency. The second was the detection of tru action potentials in the auditory nerve which equally are synchronous with the sound-vibrations, thoug over a much more restricted frequency-range. The first of these two effects, used as a convenient indicato of cochlear activity, enabled solid experimental backing to be given to the view that different frequencie evoke responses in different parts of the cochlea, and so lent further support to the Helmholtz type o theory. The second clearly carries an immediate suggestion that the alternative, telephone, kind of theor has more than a dash of truth in it. This somewhat ironic outcome was further complicated by the proble of how the auditory nerve, whose absolute refractory period is no less than a millisecond, could carry impulse at the rate of three thousand per second. It is to the resolution of these difficulties that so much of Pro Wever's scientific work has been devoted, and his presentation of the theory of hearing largely centre around these preoccupations. The book might, indeed, with greater justification have been called 'Th Volley Theory of Hearing', for the main emphasis throughout is upon the detailed working out of th hypothesis put forward by Wever and Bray according to which a number of auditory nerve fibres alternat in their activity, and so can carry frequencies beyond that to which the absolute refractory period limi the capacity of a single fibre. Most of the main topics in the subject are at least touched upon, but chiefl in so far as they contribute to an attempt to reconcile the Helmholtz with the 'telephone' type of theor by means of the volley hypothesis. Those who require a more balanced and comprehensive account o hearing generally must still rely upon Stevens's & Davis's *Hearing*, now thirteen years old.

Within the limits Wever has set himself, however, he has provided a considerable body of lucid expositio within which a large quantity of the experimental work of the last twenty years finds a place. If th

nphasis is in parts more in accordance with the trend of the argument than with the demands of objective ppraisal, the book certainly possesses an attractively individual flavour. At the same time it ought, erhaps, to be remarked that any attempt to allot a role to synchronized nerve-impulses in the mechanism hearing must rest upon an eventual demonstration that such synchrony is preserved throughout the uditory pathways as far as the cerebral cortex. At present there is no evidence that this is the case, and rof. Wever perhaps leans too heavily upon the negative explanation that the effect of anaesthetics upon ie central structures prevents such a demonstration.

From the time of Helmholtz on, discussion of the cochlear mechanisms has been bogged down by ncertainty and unwarranted assumption regarding the possibilities of resonant activity in the various ructures of the inner ear. Recent novel suggestions, especially by Gabor, and by Pumphrey and Gold, ave indicated that it may be possible to re-open these questions upon a more sophisticated level. If so, iture trends in this field may perhaps lead away from consideration of the rivalry between, or possible conciliation of, the two classical types of theory. Fresh growing points may develop in unexpected rections, and existing controversies be side-tracked. But in the meantime Prof. Wever has performed ie task of assembling the evidence to date with remarkable skill and ingenuity. All who have an interest the special senses are in his debt.

R. C. OLDFIELD

hysiological Mechanisms in Animal Behaviour. Symposia No. IV of the Society for Experimental Biology 1950. Ed. J. F. Danielli and R. Brown. Pp. viii + 482. 35*s*.

iis symposium has four main sections and comprises in all twenty-one papers by different authors. There e many distinguished contributors, among them physiologists, neurologists, psychologists and zoologists. ie four main sections are:

I. The range of capabilities of the sense organs.
II. Central and peripheral control of behaviour patterns.
III. Instincts, taxes, etc.
IV. Learning.

Section I, though it contains some useful material on the differing visual and auditory capacities of imals, is probably of more interest to the specialist than to the ordinary reader. The article by Pumphrey the sense of hearing should be of interest to the psychologist, since in it the author draws attention to e hitherto much neglected study of communication among insects and fish by means of sound. This may ove to be a topic of considerable psychological interest. Section II will primarily interest neurologists d physiologists, since many of the problems discussed involve technical issues upon which none but the ecialist can really be in a position to judge. I think that section III should prove the most rewarding om a psychological point of view. It consists largely of papers by that group of workers who describe emselves as ethologists, the best known of whom are probably Lorenz, Tinbergen and Armstrong. It ems as if the minute study of behavioural patterns, particularly those concerned with sexual display and gressive response, which is the basis of the theoretical approach of these workers, may really add some- ing new to the rather threadbare theoretical discussions upon the nature of instinct which still obtrude emselves in psychology. It seems a pity, in view of the extremely interesting material which these people ve in their possession, that they should spend so much time upon semi-philosophical issues which look spiciously like a rehash of the old vitalist mechanist controversy. Partly because they avoid this problem, e contribution of Armstrong and the interesting paper by Hartley, on interspecific recognition, are likely prove the most useful papers in this section. In view of the current preoccupation with learning theory rhaps section IV might be the focus of attention for the psychologist. However, it appears to contain atively little new material. The article by Konorski is a useful summary of his recent monograph; the ntribution by Lashley adds little to his previous writings. The article by Thorpe does however add some- ing new, partly because as a zoologist, he approaches the problem from a different angle and produces ne more uncommon material in support of his theories.

The book as a whole brings together many diverse approaches to a number of broadly related topics. th the subject-matter and the approaches differ considerably. None of the contributions is trivial but ny of them are bound, by their technical nature, to be of interest only to those with rather specialized owledge. Because of this the book as a whole may prove rather too broad in its scope for many readers. ch of the material is not particularly new, many articles being summaries of previously expressed views. t in spite of this, the book should arouse fairly wide interest.

M.M.L.

An Introduction to Personality Study. By R. B. Cattell. London: Hutchinson's University Library. 1950. Pp. 235. 7*s.* 6*d.* net.

Cattell's work on personality has hardly received the attention it deserves in the country of his origin. Thus it is particularly useful to have a short and inexpensive book which summarizes most of the arguments in his *Personality, A Systematic Theoretical and Factual Study* and some of the data from his *Description and Measurement of Personality.* Though somewhat condensed, it should not be too difficult for Honours students. His geometric explanation of multiple factor analysis is very clear. The book is well written and adequately printed, but there are some slight mistakes in names—Porteous for Porteus, Jeansch for Jaensch, and G. B. for J. B. Watson.

Cattell's major contribution is his attempt to integrate McDougall's, Freud's and others' clinical and observational studies of personality with the empirical findings of factor analysis. His stand is frankly 'biophysical'; personality is based on the individual's instincts (ergs) and other constitutional factors, modified through interaction with environment into a dynamic network of attitudes, sentiments, repressed complexes and other Freudian mechanisms. He has no use for 'culture pattern' theories, or for the view that personality depends in part on the observer. The main psychopathological syndromes, and such concepts as the Superego and Ego are identified with the so-called source traits, derived from factorization of personality ratings. One may or may not agree with all his arguments, but one cannot but admire the extent of his knowledge, and the wide range of phenomena from normal, abnormal and social psychology that he brings together in a consistent theory of personality structure. P.E.V.

An Introduction to Modern Psychology. By O. L. Zangwill. London: Methuen Home Study Books. 1950. Pp. xii+228. 5*s.*

The intelligent and scientifically minded layman, for whom this latest brief introduction to modern psychology is primarily written, is likely to find it more to his taste than any other work of the same size and intention. For Mr Zangwill avoids most of the mistakes which have brought modern psychology into fairly widespread disrepute among the well educated. He can distinguish what is scientific from what is not scientific, and keeps firmly to the scientific path; he avoids, as completely as any psychologist can, the trite and platitudinous on the one hand, and technical jargon on the other; and finally, a conspicuous merit, he is for the most part fresh and contemporaneous. The stale theories of yesterday are not validated by constant repetition, and the intelligent layman has long become both tired of hearing them and disillusioned about the progress of a 'science' that trots out again and again speculations that may possibly have amused his grandfather. He will therefore welcome a book which is both modest in its intentions and really modern in its approach. Nor will he be displeased to hear that in Mr Zangwill's judgement 'psychology at the present day is quite incapable of solving the vast majority of human social problems'. How comforting to know that the human muddle can go on for another generation or so before psychologists have learnt enough to take over and straighten it out!

In a sense, however, this work, short as it is, is more than an introduction for the layman. Under the innocent disguise of a 'Home Study Book' Mr Zangwill has written an important manifesto to psychologists. The book is written from the biological view point, and in spite of his initial placebo to the effect that 'diversity of standpoint is to be welcomed rather than disparaged', it is clear that Mr Zangwill believes that psychology cannot advance far beyond the domain of organic neurology. Doubt is thrown on the validity of a great many of the current activities of psychologists. The whole field of psychometrics is undermined by the suggestion that 'nothing psychological is truly measurable'. Testing is 'a technology whose theoretical foundations are distinctly insecure'; factor analysis 'a misguided departure from the central path of empirical psychology'. 'Social psychology remains a dream', and the psychologist 'can lay no claim to a systematic formulation of the problems of personality'. This sheaf of negations is so bulky that the psychological reader might pardonably suppose that Mr Zangwill was about to found another 'school', though his gentle and reasonable opening chapter is rather unlike the inaugural trumpet blasts that commonly herald such events! The negations, however, are probably merely a result of Mr Zangwill's neurological puritanism and without schismatic intention; though schisms they may cause!

For these judgements will, of course, be disputed by many psychologists whose concern for the scientific integrity of psychology is as keen as Mr Zangwill's. Mr Zangwill is honest enough to admit his bias, and it is hard not to conclude that he is far more predisposed to accept the scientifically imperfect claims of psycho-analysts and clinicians than those of psychometricians. Is it quite just to describe all tests and all

ntal measurement as 'arbitrary'? In fact it could be argued that Mr Zangwill is decidedly unfair to the ole broad field of differential psychology, its foundations, techniques, and conclusions. This is somewhat rprising as individual differences are of great biological importance, and their empirical study might perly be regarded as a central topic in a broadly biological psychology. Neither the theoretical founda-ns nor the research results in this field are, it is to be hoped, quite as tottery as Mr Zangwill would lead readers to suppose. Nor perhaps will neurology seem to many quite so much in the centre of the ychological picture as Mr Zangwill puts it.

Mr Zangwill is at his best and his most acceptable when he is most positive. His four chapters on perimental and physiological psychology, which constitute more than half the book, are a valuable preciation of the growing points in the fields of sensation and perception; learning; brain and mind; and petite, instinct and emotion. These chapters show the sure touch of the expert, and their references to rk carried out in the last ten or so years will open new perspectives to many laymen and probably to some ychologists.

L.S.H.

he Foundations of Common Sense. A Psychological Preface to the Problems of Knowledge. By Nathan Isaacs, O.B.E., with a Foreword by Sir Cyril Burt. London: Routledge and Kegan Paul. 1949. Pp. vi+208. 15*s.*

cording to Mr Isaacs, the method of philosophical inquiry has been predominantly one of 'circular lectical argument and debate', and has thus achieved nothing that was not already 'implicit as long as Plato', unless it be the logical empiricism of our own day. He thinks that this long-standing sterility uld be cured, and that contemporary logical empiricism could be turned from criticism to construction, proper use were made of the information about knowledge and its growth which the science of psychology n provide. He suggests further that 'psychology is the fundamental phenomenological or empirical ence: everything we can conceive or think of enters *eo ipso* into our psychic life, whatever other status may have as well', so that there is no need for psychologists to apologize for the solutions they may offer the problems that philosophers have so obviously failed to solve. In his view, 'the true basic experi-ntal datum' is not sensations or sense data, but what he calls 'a focalized field'; within this, various pes of 'experience' (affective-conative, receptive-perceptual, active, and cognitive) may be distinguished; filled and thwarted expectations are 'the first and controlling psychological basis for our distinction tween truth and falsity', the basis of our knowledge of the objective world is the distinction between r body and what is not our body, along with the success attending the set of expectations to which this tinction gives rise; the notion of causality is developed from the control of things over people and of ople over things; puzzlement is a state of 'general unrest' while 'an accepted explanation is the return rest', though 'the inquirer's *criteria of what constitutes a valid explanation* will determine in what cumstances he will settle down, in what others he will go on with his search'.

Mr Isaacs assumes in his readers a general familiarity with epistemology and is not very specific about at are the problems to be solved. As a consequence, his criticisms of the psychological assumptions of aditional philosophers' are not as pointed as they might have been. In any case, the days when ilosophers made uncritical use of such abstractions as 'sense', 'understanding', and 'the mind', are g passed, and philosophizing physiologists or psychologists are to-day more likely to hit up against nse data' than are the rather disillusioned debunkers who predominate in philosophical circles. cidentally, is 'the child', whose 'experiences' are so fully explored by Mr Isaacs, noticeably less abstract an 'the mind'? 'The mind' was generally identifiable as that of the writer of the book, but whose child is e child'?) Mr Isaacs makes many references to 'criteria', but in my opinion he slurs over the difference tween the typical *philosophical* inquiry into the types of criteria we employ and the nature of criteria in neral, and the *historical* inquiry into the criteria in fact employed by different people at different times d places. Furthermore, his view is not quite as provocative as it might seem at first, since he himself mits that the psychology that is philosophically basic is not the experimental and laboratory science, t something closely concerned with the establishment of meanings or concepts. The present work is ridged from a larger one which has not yet been published, and it is probable that in that work there is nore detailed account of what the problems of epistemology are. Mr Isaacs is, by virtue of his philo-phical and psychological accomplishments, well equipped to deal with these problems, but the merits of present book consist rather in points of detail (for example, his account of how 'what is immediately ceived becomes a smaller and smaller nucleus in a constantly expanding context or system of beliefs') an in the bearing of the whole.

H. B. ACTON

Theory of Knowledge; An Introduction. By A. D. Woozley. London: Hutchinson's University Library. 1949. Pp. 196. 7*s.* 6*d.*

This book can be heartily recommended as an admirable introduction to epistemology. Woozley gives us a contemporary discussion of the standard questions—judgement, memory, universals, truth, knowledge and belief; and provides us with a model of clear-headed and incisive argument.

Rather surprisingly, however, there are two points of psychological interest which Woozley does not seem to have thought out. He says that the methods of psychology 'are those of natural science, with the severe handicap that its subject-matter is not available for direct inspection (except in the case of the experimenter himself), but has to be inferred from the observed appearances and behaviour of human (or sometimes non-human) bodies'. This statement is likely to bewilder most psychologists; naturally, since the handicap is an illusion—the result of a philosophical hangover. Then, in trying to distinguish between psychology and the theory of knowledge, he says that, if we take memory as an example, the psychologist is interested in causal questions about it, whereas the philosopher 'wants to know what he is doing when he is remembering, and in particular... "what is a memory image?", "what is the relation between the image present in remembering and the experience remembered?"...'. Unfortunately, this will not work as it stands, since the psychologist is much interested in these very questions. Surely the more useful first step is to say that the contemporary epistemologist is largely concerned with our use of 'epistemological' words in ordinary speech, and with the philosophical problems that this usage generates?

B.A.F.

The Psychology of Intelligence. By Jean Piaget. Translated by Malcolm Piercy and J. D. Berlyne. London: Routledge and Kegan Paul. 1950. Pp. 182. 15*s.* net.

This volume, the latest of Prof. Piaget's copious output to be translated, may be termed a retrospective summary of the work of many years. Partly for this reason it will be for some, a difficult book. For the logical argument which occupies the first part is a concise re-statement of the ideas presented in detail by the author in earlier works on the development of notions of space, time, geometrical and logical relations, etc., none of which has so far appeared in English. In these works Piaget made use of the terminology of thermodynamics as appropriate to the description of mental mechanisms in developing equilibria. Thus the present work not only assumes some acquaintance with these past productions but also familiarity with mathematics and logistics.

Whilst this may seem strange to some British psychologists I believe that to follow the line of progress which Prof. Piaget has marked out for his own necessitates the acceptance of a language and calculus capable of describing the progressive fluid states of equilibrium constituting the various stages of growth in intelligence, for which existing psychological terms are inadequate. Proceeding from an analysis of the relations between thinking and logic, Piaget shows the essential minima required from psychological mechanisms in order to carry through logical operations, suggesting that a genuine elucidation of such operations should demonstrate experimentally the genesis of logical thought, involving conceptual abstractions, from simpler forms.

For this purpose he considers the relations between thought and perception—thought treated as the completion of the route to knowledge of the object at a greater remove from the immediate contact entailed in the perceptual relation. Perception is considered as a statistical process, a series of 'samplings' of the object. Thus Weber's Law is adduced as evidence of the statistical character of perception. Perception is, moreover, an 'irreversible process' based upon physiological regulations of the kind envisaged in the production of perceptual 'gestalten' and as such, contrasted with the processes of logical thought, these latter being considered essentially reversible.

After a brief review and critique of the work of the 'Denkpsychologie' school (Selz, Dunker, Buhler) Piaget embarks upon the actual description of the phases of development which thinking undergoes in the growing child, interpreted in terms of the theoretical views put forward, and illustrated by the experimental studies carried out at the Institut Jean Jacques Rousseau during the past thirty years.

The author outlines the process of the ordering and 'dimensioning' of the child's experience as he passes from the egocentric and phenomenal world in which there are no objects and no dichotomy of 'I' and 'not I', through the stages of 'sensori-motor intelligence'—the level at which operations of thought can be carried out with concrete objects but at which it is still pre-conceptual—to the final development of abstract conceptual thought.

t the basis of the theory lie, not 'elements of thought' in the form of logical elements, nor gestalt ogisms (Wertheimer), but rather, a set of schemata which Piaget terms 'groupings', analogous to, yet inct from, the notion of the 'group' in mathematics. These are to be regarded as topological dimensions hich the several logical operations, i.e. displacement, seriation, etc., can be carried out whilst fulfilling requirements of thought, namely conservation and reversibility.

ack of space prevents critical discussion of these notions, yet it should be clear that there is much to ulate careful thought and analysis.

he translation is competent and straightforward, though the reader is here and there aware of sharp es presented by technical expressions couched in an unfamiliar idiom. Whether it is possible to find ent equivalents for these without distortion I am not at all sure, but the effort to do so would be very th while.

J. LANGDON

ree Essays on the Theory of Sexuality. By SIGMUND FREUD. Translated by JAMES STRACHEY. London: Imago. 1949. Pp. 133. 10*s.* 6*d.* net.

'em and Taboo. By SIGMUND FREUD. Translated by JAMES STRACHEY. London: Routledge and Kegan Paul. 1950. Pp. xii+172. 14*s.* net.

eud: Dictionary of Psychoanalysis. Edited by NANDOR FODOR and FRANK GAYNOR, with a Preface by THEODOR REIK. New York: Philosophical Library. 1950. Pp. xiv+208. $3.75.

e Interpretation of Dreams. By SIGMUND FREUD. 17th impression, 3rd English edition. Translated by A. A. BRILL. London: George Allen and Unwin. 1950. Pp. 600 (lacking 4 preliminary pages). 16*s.* net.

any psychologist concerned with Freud's views it is of the greatest convenience to have in accessible n a good translation of the three papers in which he attempted, and revised from time to time, stematic exposition of his views on sex. These views have by now become familiar, but they can be, are, so easily misrepresented that Freud's own statements deserve to be frequently consulted. They not always perfectly clear, for the book is more systematic than precise; but here at all events is an anized and comprehensive statement of his views under the three main headings of 'The Sexual rrations', 'Infantile Sexuality' and 'The Transformations of Puberty'.

. A. Brill's translation of *Totem and Taboo* in 1918 has now been followed by a 'new authorized nslation' by James Strachey which reads less like a translation. At many points it uses more words and empts less compression, and the result appears more readable and comprehensible. The following sage is fairly representative of the difference: 'After they had satisfied their hate by his removal and carried out their wish for identification with him, the suppressed tender impulses had to assert nselves. This took place in the form of remorse, a sense of guilt was formed which coincided here with remorse generally felt. The dead now became stronger than the living had been, even as we observe -day in the destinies of men. What the father's presence had formerly prevented they themselves now nibited in the psychic situation of "subsequent obedience" which we know so well from psycho-lysis' (Brill). The new translation reads: 'After they had got rid of him, had satisfied their hatred and put into effect their wish to identify themselves with him, the affection which had all this time been hed under was bound to make itself felt. It did so in the form of remorse. A sense of guilt made its earance, which in this instance coincided with the remorse felt by the whole group. The dead father ame stronger than the living one had been—for events took the course we so often see them follow in nan affairs to this day. What had up to then been prevented by his actual existence was thenceforward nibited by the sons themselves, in accordance with the psychological procedure so familiar to us in cho-analyses under the name of "deferred obedience".'

f *Freud: Dictionary of Psychoanalysis* it should first be noted that it is not a dictionary in any ordinary se. It is more like an anthology, with brief passages from Freud's writings brought together under nabetically arranged headings. Under 'Beauty', for instance, is the entry, 'Beauty is an instance which nly shows that culture is not simply utilitarian in its aims, for the lack of beauty is a thing we cannot rate in civilization'. Much of the book is of this order of futility, but more purpose is served by ies under such headings as 'Id', 'Libido', Transference', etc., where it may at times be useful to

discover promptly Freud's main uses of the term. Few exact definitions appear, and the book inevitably reveals the weaker side of Freud's work by inviting attention to his tendency to elaborate theoretical structures without precision and clarity in basic concepts.

The Interpretation of Dreams, in A. A. Brill's translation, is a re-issue of the edition of 1937, already reprinted several times. The printing is uneven and poor, with many letters imperfect, and is quite unworthy of the importance of the book. But we must be grateful to have the work in print of some sort. Freud's own remark in his Foreword to the English edition of 1931 would command wide agreement among psychologists: 'It contains, even according to my present-day judgement, the most valuable of all the discoveries it has been my good fortune to make.'

Religion as Experience, Belief, Action. By Sir Frederic Bartlett. Riddell Memorial Lectures. Oxford University Press. 1950. Pp. 39. 2*s.* 6*d.*

I have to confess to some disappointment at these lectures. What Prof. Bartlett does is to accept the supposed limits of psychology in dealing with religious experience, and to characterize this experience—to use his own words—as being 'based upon evidence or information which appears unfinished, which is completed by an intuitive leap, and which completion is treated as coming from an outside source, from a world the constitutent items of which do not have the properties of the items of evidence'. If, however, he goes on, we 'make any kind of leap from data that are unfinished to data or conclusions that are regarded as complete, we land up in a belief'. This is just what happens in religious experience, and this is part of the reason why every religion must develop beliefs. Unlike other beliefs which are justified by being verified, these beliefs are justified by results and in action on the part of believers. 'Religious belief is especially closely bound up with difficulties and crises of a personal and social order', and so is likely to 'pass over easily into action'. However difficult it may be to say what actions are religious, the general function of religious action is the same as that of any other kind, viz. to try 'to cope with pressure that is exerted from the environment, physical, personal and social'. And Prof. Bartlett says that he has neither the right nor the knowledge to reject the testimony of others that 'It is God working through me' in their actions. He ends as follows: 'I think we can see it (i.e. religion) in all its forms as an answer which man must attempt, in accordance with his constitution and endowment. Whether it has other warrant is not for a psychologist to presume to pronounce; I see it all as a vast risk and continuing adventure, which must go on and on, and cannot, will not, admit defeat.'

I have picked out some of the essentials of his argument. I find these essentials and the argument as a whole disappointing for various reasons. They do not constitute a philosophical contribution. For instance, he accepts the traditional view that the truth or worth of religion is logically independent of any account of it that psychology can provide. But it has become evident in recent years that this view is naïve and will not do at all, because the effect of psychological work is to incline us to classify religious beliefs as superstition. Consequently their logical independence from psychology is irrelevant. Likewise, his acceptance of the naïve interventionist view (that 'God can work through me') will not do either. Nor am I sure that I can detect the psychological contribution in these lectures. Clearly, they do not present new experimental or observational material. Presumably, therefore, they are intended as a theoretical excursion. But to say, for example, that religious experience consists, in part, 'in a leap from unfinished data to complete conclusions' is to say something familiar and so figurative and vague that it must fail to qualify as a contribution to psychological theory. Again, what reasons has Prof. Bartlett for saying that religion is 'an answer which man must attempt in accordance with his constitution and endowment'? I found the argument so vague and devoid of examples that I am unsure whether he has produced any reasons or not for this challenging conclusion.

It would have been better, I think, if Prof. Bartlett had covered very much less ground in the thirty-eight pages; or else had given himself the space to deal thoroughly with the complex issues through which he has conducted his introductory tour. B.A.I

her Land: A Study of Authoritarianism in the German Family. By Bertram Schaffner. New York: Columbia University Press. 1948. Pp. 203. $3.25.

twar Germans: An Anthropologist's Account. By David Rodnick. New Haven: Yale University Press. 1948. Pp. 225. $3.75.

ı authors came to Germany as members of the Information Control Division of the Office of the rican Military Government, and their work covers the period from December 1945 until the middle 946.

r Schaffner is a psychiatrist and served with the Screening Centre in Bad Homburg where German icants for licenses to carry out work in the information services were vetted. Each candidate was nitted to an intelligence test, a Rorschach test, a sentence completion test, a psychiatric and a political ysis interview. As a result he was graded in one of five categories ranging from White A, clear-cut -Nazi, to Black, believing in the principles underlying Nazism. The book draws on the experimental ence and on the author's personal experience gained from varied contact with Germans over a period wenty-five years. The main theme is the authoritarian father. He is the undisputed head of an rchical family, does not tolerate any opinion but his own and expects obedience from all members of family including his wife whose position is secondary. The typical German wife is described as subdued, ive, willing to suppress her own beliefs and to agree with her husband. The author holds that this ern is representative for the German family and that it is perpetuated through the identification of the with the father. He tries to show how orderliness inculcated into the child leads to rigidity and tance to change, emphasis on manliness to militarism, exaggerated family pride to nationalism, and hierarchy within the family to the adult's attitude toward authority and his acceptance of a caste em with many superiors and inferiors but few equals. For the re-moulding of Germany the author ests a programme which should aim at a change in the attitude toward parental authority, at equal ıs for women, at teaching the children to think for themselves, and at making the Germans themselves re of the restricted life they are leading.

r Schaffner is a lucid writer who knows how to present his case but the book would have gained in e if the line of demarcation between experimental evidence and personal experience had been kept er, if generalizations had been more carefully avoided and the attempt had been made to check some ıe test results with comparable American groups.

r Rodnick's approach is that of an anthropologist. In five months he and his wife visited private es, questioned or observed large numbers of people, interviewed informants belonging to all classes of ty and to different political parties, attended meetings, inspected schools, gave questionnaires to ral hundred children and an essay on 'the future of Germany' to senior grammar school pupils. ough Dr Rodnick confined his investigations to the American controlled part of the province of e he generalizes freely to the whole of 'German Protestant culture'. In the German Protestant family wife is the symbol of authority and the father is expected to back up her orders. The women are more essive than the men 'who have not been eager to play the role of the dominant male' and 'any iarchal pattern that may have existed in German Protestant culture has become obsolete; we found races of it'. The family is democratic, boys and girls, older and younger children alike, all have equal ts. Boys are less encouraged to be manly than in America. Obedience is conditioned through affection ward and rejection as punishment and an idyllic childhood prepares youth badly for the world of the t. The author sees the German problem in the clash which occurs when the adolescent comes into act with the outside world and a rigid caste system which does not continue the family pattern and not reward his efforts. Social values which force the individual to judge his fellows in terms of riors and inferiors lead to self-pity and aggressiveness, and, if the same principles of evaluation are ied to international relations and one's own country is seen as underprivileged amongst more privileged ons, extreme nationalism must result. The problem is to break down the class hierarchy and to develop es which give more satisfaction to the individual. The author presents a wealth of material and his unt is an invaluable document by a sympathetic observer showing how a segment of a nation reacted feat and starvation. It would, however, be interesting to know how the author explains the acceptance perpetuation of the caste system. One feels also uneasy as to whether methods which apparently e successful in a primitive society, where area and numbers are defined, are adequate for the study of estern culture, without exactly delimiting the geographical boundaries and the size of the sample; ner whether the results thus obtained can be applied with confidence to millions of people of widely ring traditions brought together by the author under the possibly arbitrary heading 'German estant culture'.

The two writers have in many respects arrived at a very different picture but one may hold tha contradictory features are likely to coexist in a highly complex culture. Why both authors only becam aware of one dominant pattern is a question to which other workers in the field may wish to turn the thoughts. The two books have to be viewed as pilot studies and their great merit lies in the courageou use of a unique opportunity. A. KALDEG

Culture and Personality. Proceedings of an Interdisciplinary Conference held under th auspices of the Viking Fund. New York Viking Fund. 1949. Pp. vi + 210. $1.50 net

It seems as if a number of the best and most widely known American social psychologists, anthropologist and sociologists thought, or were induced to agree, that if they came together into a very free-speakin conference they might 'discipline' one another into arriving at something definite about methods an results in the study of culture and personality. This publication, edited by S. Stansfield Sargent an Marian W. Smith, reports the result, the leading communications being printed in full, and the followin discussions, somewhat abbreviated and bowdlerized, one suspects, appended. It is extremely interestin to read. The main headings are: 'Culture and Personality'—Defining our Terms; Techniques for Studyin Culture and Personality; Evolution of Studies; and Integration for Future Studies. With such wide topic it is no matter for surprise that although the main contributions are all very serious and critical, the are also for the most part in extremely general terms. If the truth is to be told when these papers an the comments following them are carefully considered, we seem to be left not far from where we started Still, if the Conference and its Report, allow us to conclude that in this highly exciting field of study th contributors must define their terms as clearly as they can and stick to the definitions, the critics mus bother less about the content of the definitions than about their consistent employment, and both mus give at least as much attention to the methodology of the collection of data as to that of their communica tion, perhaps something will have been gained. F.C.

Job Evaluation Practices. Industrial Relations Centre, University of Minnesota. Mimeo graphed Release 2. 1950. Pp. vi + 119.

This book consists of the proceedings of a two-day Conference held in 1949 in the University of Minnesot Nine different writers contribute, and the articles range from a general survey of the history and purpos of job evaluation to a fairly exact examination of specific systems in use.

There is a general looseness of thinking and lack of definition in the whole subject of job evaluation, an this book does two useful things. On the one hand, it gives clear warnings against the tendency to clai for this application of scientific method, an exactness that is not justified. The claims of independen experts are shown to be conflicting, and the conflicts generally arise from the desire to attribute precisio to job evaluation. On the other hand, the book succeeds in demonstrating the complexity of job evaluatio and in putting it into proper perspective against a social and cultural background.

The broad purpose of a job evaluation study is to ensure that a wage structure has a rational basis. Th case for the study is made in an early sentence: 'Nothing, I think so depresses the morale of a workin force as the payment of different wages to men working side by side on the same type of work.' While w may accept the broad truth of this sentence it demands some qualification. It is not enough just to measu and equate job content; tradition, social customs, prestige values, the whole social background, must b taken into account. Nevertheless, a more equitable wage structure is possible if it is based on as exa a knowledge of job content as can be obtained.

When job evaluation was the province of the industrial engineer there was a real danger that th engineer's philosophy would operate at the expense of human feelings and attitudes. The entry of th psychologist into the field gives a better chance that this danger will be avoided.

There has also been confusion as to the meaning of the various terms, job evaluation, job analysis an job description or job specification. The definitions given are useful and timely. Job evaluation is a overall term to embrace a number of subsidiary elements. The job analysis is the first step and it leads the job description: rating or evaluating the job follows and is then used to build up the overall wag structure.

Finally, the authors stress the importance of flexibility in any scheme. No scheme of job evaluation ca provide an absolute mathematical value to a job. The whole life of a factory is dynamic, and changes details of work demand continuous study by the team concerned with evaluation.

By means of a carefully worked out scheme, applied dynamically, the cruder injustices of different wages can be eliminated. H. G. MAU

xperimental Design in Psychological Research. By Allen L. Edwards. New York: Rhinehart. 1950. Pp. xvi+446. $5.00 net.

uch a book is overdue and this will serve to provoke thought and discussion. The chief difference between and standard statistical text-books lies in the wide variety of experimental situations adduced. Standard ethods, apart from factor analysis and sequential analysis which are not mentioned, are all discussed with ference to examples while many more situations are left to the ingenuity of the reader. About half the ok deals with analysis of variance in some form.

So far, so good: but for psychologists there are defects which stem from undue emphasis and reliance on atistical method. It becomes oppressively clear, for instance, if it was not clear before, that figures, even hen extracted from the report of a psychological experiment and called response times or test scores, have psychological implications or significance in themselves. Again, where assumptions about an experiental situation are made explicit it is generally clear that more are needed. Finally, while the effects of aining are traditionally a matter for investigation, the author follows standard practice in neglecting the anging state of a human subject in the course of an experiment. B. BABINGTON SMITH

n the Psychology of Artistic Enjoyment. By Sylvi Honkavaara. Helsinki: Suomalainen Tiedeakatemia. 1949. Pp. 161. No price given.

his thesis puts forward no new experimental data but surveys other psychological work on aesthetics in spirit of constructive criticism and offers a general framework for the discussion of aesthetic problems. ather than testing hypotheses experimentally the author exemplifies her points of view with instances awn from a wide range of material in the arts and in everyday experience. This procedure carries with it ie familiar risks of selective observation and interpretation, with an occasional skid into the weaker sort anecdotal evidence, but it makes possible the discussion of a broad field and allows of direct reference to pics of general interest. The book comes therefore as a relief both from the remoter philosophical treatent of aesthetics and from some of the more footling studies of recent experimental psychology. It rovides a useful survey for students embarking on experimental research into any of the significant roblems of aesthetics.

The author draws largely but not uncritically on Gestalt concepts, which serve her best in the section on rtistic Enjoyment Based on Immediate Perceptional Impression'. In the other main section of the book, ealing with the representational aspects of art, it is harder to believe that the viewpoint of the Gestalt hool has appreciably aided her exposition, and the claim to establish with its aid a fundamental connexion nong the different arts seems unconvincing. But the greater part of the book is notably free from this ver-synoptic effort.

The loss of ease resulting from the book's appearance in translated English is off-set by its agreeable flexion, in references and examples, of the cultural activities of Finland—a local colour that is compatible ith a close relation to the art and thought of the main cultural centres of western Europe.

Musical Taste: its Measurement and Cultural Nature. By P. R. Farnsworth. Stanford: University Press; London: Oxford University Press. 1950. Pp. 94. Price 12*s.*

his monograph, whose total length is only 94 pages, provides a closely packed survey of American and ritish studies of musical taste and its assessment. It consists of seven chapters. In the first two rof. Farnsworth is concerned to show (with supporting evidence from his own and other research) that fficiently marked trends can be found in, for example, specialist and student opinion, incidence of mposers' works in American broadcasts, recording and concert programmes, and space allocations in usical histories and similar literature, to suggest that taste however defined is not a matter of whimsey. n the other hand, there are sufficient individual differences and changes in musical standards to suggest at anyone adopting an absolute position (illustrated by the Professor who feared for his students' pollution' by Mahler and Bruckner) is on dangerous ground.

Three further chapters deal usefully and critically with methods which have been and might be used to ssess taste. Chapter 6 deals with conditioners of taste and Prof. Farnsworth is clearly aware that the vidence he has produced on trends could be interpreted as evidence for stereotypes. In chapter 7 rof. Farnsworth deals particularly with the results of his own researches at Stanford on the relative minence of different composers.

The writing is lucid and unpretentious. Where space permits discussion as against exposition, Prof. Farnsworth seems to maintain a nice balance between respect for statistical methods and for the quality of the data to which they relate. The results quoted vary considerably in interest. In the reviewer's opinion the monograph is mainly valuable as a source of reference to work that has been carried out in the field it covers. The only obvious omission noted is to Dr Wing's research, the results of which may have become available too late for inclusion in Prof. Farnsworth's otherwise useful monograph.

Can We Agree? A Scientist and a Philosopher Argue about Ethics. By CHAUNCEY D. LEAKE and PATRICK ROMANELL. Austin (U.S.A.): University of Texas Press. 1950. Pp. xiv + + 110. No price given.

The discussion which this book contains is interesting but unsatisfactory. It consists of two papers and two rejoinders. The philosopher's criticisms of the original scientific paper are not answered. The scientist wishes to substitute descriptive for normative ethics, and to find a naturally operative ethical principle. What he suggests is: 'The probability of survival of a relationship between individual humans or groups of humans increases with the extent to which that relationship is mutually satisfying' (p. 49). (He takes this principle to be a corollary from the principle that survival depends on harmony with the environment and within the group.) He then goes on to argue that, if this is true, then ' it is *incumbent* upon an individual to help make the relationship in which he participates with another individual as satisfying to the other individual as to himself' (p. 27). This is, he immediately leaves the descriptive for the normative. This failure to see that, if the normative is eliminated what remains is not ethics but sociological generalization, and the further failure to see that the normative cannot logically follow from the descriptive is characteristic of most 'scientific' ethics. It is depressing that the answer to the question which forms the title to this book is 'No; we can't even understand'. The fault here is with the scientist and not with the philosopher, who has some interesting things to say about naturalism and ethics.

WINSTON H. F. BARNES

Immediate and Retention Effects of Interpolated Rest Periods on Learning Performance. By BERTRAM EPSTEIN, Ph.D. New York: Teachers College, Columbia University Contributions to Education, no. 949. Bureau of Publications, Teachers College, Columbia University, 1949. Pp. xvi + 80. $2.10.

Dr Epstein's monograph continues and amplifies two earlier publications in the same series—those of Lorge (no. 438, 1930) and Gentry (no. 799, 1940). The main problem studied is that of 'distributed' versus 'massed' practice in a simple learning process, with particular emphasis upon retention, as measured by re-learning. The situations studied were of a traditional type—code substitution, and mirror-reading, i.e. comprehension of mirror script as evidenced by fulfilment of very simple instructions similar to those commonly used in group intelligence tests.

The expected superiority, in general, of distributed as against massed practice was once again demonstrated. An explanation is sought in A. G. Bills's concept of 'blocking', which implies individual variations in rhythm of mental work, shown in the occurrence of spontaneous non-productive pauses. On the other hand, from a study of effectiveness of retention among subjects who accomplished equal learning under differing conditions of original practice, the author shows that the amount of total accomplishment during this original practice is of greater significance in predicting subsequent performance than the particular distribution of work and rest periods under which the initial learning was carried out. Both of these findings seem to point to a need for increased recognition of individual differences in the quantitative study of learning processes.

One would have liked to see a fuller discussion of the theoretical implications of these findings, and perhaps some proposals for the study of their application to situations more open to the influence of 'real-life' motivation. As it stands, the form of presentation, with very full tables of numerical data, prevents the book from rising from the status of a research report to that of a reasoned contribution to learning theory.

B.S.

Sterilization in North Carolina. By Moya Woodside. North Carolina University Press; London: Geoffrey Cumberlege. 1950. Pp. vxi+219. 20*s.* net.

The author, a psychiatric social worker from England, has spent a year and a half on the study of the practice, law and some consequences of sterilization in North Carolina. In this State, where eugenic sterilization has been legal for seventeen years, great fertility is characteristic for both the negro and white population. Therapeutic sterilization is within the discretion of the surgeon. The author has found that eugenic reasons for the operation are rarely unaccompanied by medical or social indications and she is less concerned with future genetical effects than with the immediate effects of sterilization on the individuals concerned and their families and on the community.

Between 1933 and 1947, 1852 eugenic sterilizations have been performed in North Carolina, of which more than two-thirds have been women. The majority of sterilizations was authorized on grounds of feeble-mindedness, about 400 for mental disease and more than 200 for epilepsy. In the males vasectomy was predominantly practised, in the females it was salpingectomy or tubal ligation. Whites and negroes contributed to the material roughly in proportion to their numbers in the state population.

The intricacies of compulsion and consent inherent in all sterilization legislation are pointed out by the author and comparisons made with the situation in other states and countries.

In a follow-up study of forty-eight married sterilized women the age, fertility, reason for the operation and its effects on general health were analysed as well as its effect on menstruation, libido, frequency of intercourse, capacity for orgasm, the husband's attitude and other factors. The conclusion is that, on the whole, 'sterilization had conferred great practical and psychological advantages and could have been even more constructive if earlier undertaken in a number of cases'. The main beneficial effects were an easing of the burden of exhausted women and the prevention of children, who would have been greatly handicapped by the quality of their home, by poverty and occasionally by their inborn qualities.

H. KALMUS

The British Journal of Delinquency. Vol. 1, no. 1, July 1950. London: Ballière and Cox. Pp. 76. 7*s.* 6*d.* per copy.

There is now a sufficient body of knowledge, theory and research to warrant the publication of a journal which will 'enable students of criminology to keep in touch with recent developments in the various branches of science concerned with the investigation, treatment and prevention of delinquency'.

The first number contains an account of 'The Psycho-Analysis of a Case of Stealing' by Hedwig Schwarz, the first instalment of 'A Comparative Survey of the Wakefield Prison Population in 1948' by W. F. Roper, and an interesting analysis of British Press cuttings expressing views about delinquency by P. D. Scott.

The editors have wisely invited contributions from foreign sources, which will enormously increase the value of the *Journal*. There is 'A Note on Capital Punishment in the United States' by Thorsten Sellin, an account of 'The Criminological Institute of the University of Stockholm' by Olaf Kinberg, and P. A. H. Baan provides a note on Psychiatric Observation in the Dutch Prison System. Heinrich Meng and Paul Reiwald contribute a theoretical discussion of certain aspects of 'The Prevention of Delinquency', in which they make reference to an interesting social experiment in Cleveland, Ohio.

In addition to these articles there are notes on current research, reviews, and abstracts of articles from other journals.

W.J.H.S.

Adler's Place in Psychology. By Lewis Way. London: Allen and Unwin. 1950. Pp. 334. 18*s.* net.

The views of Alfred Adler are here presented with thoroughness and fidelity and in a style infinitely more readable than that of his translators. So great has been the author's success in this respect that he unwittingly reveals many of the weaknesses, other than those admitted in the penultimate chapter, which perhaps help to account for the impotence of Adlerianism in this country.

'Individual Psychology', wrote Adler in 1933, 'ought to employ nothing but purely scientific methods, it must remain a pure science'. Patently Individual Psychology never has been a pure science, and in the last seventeen years little has been seen of scientific methods directed towards the verification of the few hypotheses put forward. One cannot live indefinitely on apéritifs. Not only have such methods remained

virtually unused, but their use elsewhere on pertinent topics has been ignored. There is, for example, no recognition of the work done on sibling position and ably summarized by H. E. Jones, which lends little support to Adler's views. Again from the dust cover we learn that the layman can read this book with pleasure and even amusement. The psychologist who reads Adler's views on intelligence (pp. 222–3) will be able to share in this amusement.

A chapter on 'Wholeness and Purpose', which owes little to Adler, sometimes brings the story more up to date—though, in his arguments against mechanism, Mr Way perhaps underestimates the machinations of the Cyberneticists. Since little, if any, advance from the original Adlerian position is claimed and since Adler's own books were extremely simple, the justification for the present volume remains obscure. A book summarizing developments from, and verifications of, the original hypotheses of Adler would have been more welcome. G. A. F.

The Inner World of Man. By Frances G. Wickes. London: Methuen. 1950. Pp. vi+313 and appendix of 79 illustrations. 21*s.* net.

Intended for general reading but not misleadingly oversimplified, this book begins with a general account of Jungian beliefs and proceeds to detailed reports of individual analyses. The patients reported on seem all to have been people of good intelligence and education who could respond appreciatively to the conscious formulation of meanings conveyed by the symbolism associated with the arts and religion. The material for interpretation was in some cases mainly dreams, in one waking fantasies, in another hallucinatory visions, and in some drawings. Illustrations of many of the drawings in the familiar pictorial idiom of Jungian analysounds, add greatly to the value of the book.

Recent Experiments in Psychology. By Leland W. Crafts, Theodore C. Schneirla, Elsa E. Robinson, Ralph W. Gilbert. Second Edition. New York, Toronto, London: McGraw Hill. 1950. Pp. xviii+503. 28*s.* net.

This is the second edition of a book designed, in the words of its authors, 'to make available to the college student and to the general reader investigations which are representative of the modern experimental treatment of important psychological topics'. Those who take it up expecting to find an account of the most recently performed experiments in psychology will find that they have been misled by the title. The authors' statement in the preface that 'not every experiment reported is recent in the sense that it has been performed within the last decade' might well have been given greater prominence.

The book consists of twenty-six chapters dealing with a wide variety of topics. Some indication of the range may be conveyed by such newly included items as belief in mysticism among college students, the perception of obstacles by the blind, conflict and experimental neurosis in cats, the value of organization for retention and transfer, the perception of the vertical in space, projection and the Thematic Apperception Test, and the opinion-poll technique. Each chapter is based on some well-known experimental study, and follows a general plan of a short introduction to the topic, an account of the experiments, and a discussion of the results obtained. The source of material for each chapter and other references are clearly indicated so that the reader will have no difficulty in pursuing the subject further. One exception to this is chapter XI, on Organic Nervous Diseases in relation to Behaviour, which is entirely descriptive and appears to have strayed from a text-book on neurology. It certainly does not conform to the general pattern of the book.

The value of such a symposium is always difficult to assess. The absence of a central theme makes it impossible for the reader to know what he is likely to find without reading the index of contents for each chapter. Some will be interested in only a fraction of the book, and will prefer to consult the original papers and articles rather than the versions given here. But it is a useful reference book, and one which should give the undergraduate student of psychology an understanding of the many problems which have been investigated by experimental method. S. B. N. SHIMMIN

Psychology. Principles and Applications. By M. E. Madigan. London: Henry Kimpton. 1950. Pp. 385. 30*s.* net.

According to the author's preface, this book is intended to serve as a brief introduction to psychology as an experimental science and to emphasize its applications in education and in problems of individual and social adjustments. In fact the student addressed is almost invariably the student nurse, and a considerable interest in sick people and hospital training is assumed throughout.

Again, according to the preface, a 'consistent effort has been made to avoid an academic attitude' and to use instead 'a therapeutic approach by providing opportunities for active learning'. The impression left by this technique, on any reader not well acquainted with American methods of education, therapeutics, and nurse-training, is of verbosity and repetition which could have been avoided had the 'academic attitude' been used to order and develop the themes of the book more carefully. Such usefulness as the book may have, for any student with time and patience to study it carefully, is obscured by this lack of attention to orderly arrangement of material. As is so often the case with the 'brief introductory' type of text-book, there are many irritating generalizations and inexactitudes, both as regards psychology and as regards clinical medicine.

It is doubtful how useful the book is for the British student. For the student psychologist there is too little necessary detail. For the student nurse there is too much unnecessary detail, as well as the assumption of background knowledge not generally found in this country. M.F.

Fatigue and Efficiency in the Textile Industry; A Psychological Investigation. By Kali Prasad. India: Lucknow. 1950. Pp. vi+34. 2*s.* 3*d.*

This short report summarizes the aims, methods and results of a preliminary investigation on fatigue and efficiency in the Swadeshi Cotton Mills, India. It is mainly a collection of tables and graphs of hourly and daily variations in output on different shifts. Criteria of performance were (*a*) the highest rate of working attained in a period of 30 minutes, (*b*) the ratio of actual to possible output, and (*c*) the results of interpolated tests (steadiness, speed of reaction, and eye and hand co-ordination). The results in general seem to have much in common with those obtained in earlier investigations in this country, but the numerous brief and often dogmatic statements together with the lack of information on hours of work, rest pauses, the method of sampling and the number of workers in some of the samples make interpretation difficult and accurate comparison impossible. Also, the reader is jolted by pretentious and unwarranted statements such as 'The data when plotted graphically are approximations to the followings types of curves: (*a*) unimodal or bell-shaped curve, (*b*) a negatively accelerated curve, (*c*) curve with uniform cycle, (*d*) a ladder-shaped curve, negatively accelerated, (*e*) an uneven or ambiguous curve.' The investigation was intended as a prelude to more specific studies of fatigue and to this extent it may serve a useful purpose. S.W.

The Mystery of Dreams. By W. O. Stevens. London: Allen and Unwin Ltd. 1950. Pp. 280. 16*s.* net.

This is a collection of stories of dreams of various types mostly illustrating some paranormal process, such as precognition. The majority of the stories have been published before and will be familiar to those who have read widely in such literature. The book is to be regarded not as a contribution to scientific psychology but as popular literature. As such it is deserving of praise. The stories are well selected to arouse interest and might lighten the leisure hours of the tired psychologist. R.H.T.

Psychosomatics and Suggestion Therapy in Dentistry. By Jacob Stolzenberg. New York: Philosophical Library. 1950. Pp. xii+152. $3.75 net.

It is deplorable if psychology has nothing better than this book to offer to the profession of dentistry. The author has made use of hypnosis and post-hypnotic suggestion to induce over-anxious patients to accept dental treatment and his account may serve to introduce dental surgeons to the possibilities in this direction. He gives instructions for inducing hypnosis and indicates its main uses in dental practice. These include the removal of apprehensiveness, the prevention of 'gagging' during the taking of impressions,

and the production of analgesia, or anaesthesia (though he advises against reliance on hypnosis alone for the last purpose). Apart from this, the book gives a superficial and over-confident account of psychosomatic disorders (among which is included accident-proneness), poorly assimilated scraps of Freud and of Sheldon, and a pep-talk on the personality traits needed for building up a successful dental practice. It is not reassuring to gather from the illustrative cases that dental practice extends to the hypnotic treatment of tinnitus, stammering and dysmenorrhoea.

Character Analysis. By Wilhelm Reich (Translation by T. P. Wolfe). Third Edition. London: Vision Press—Peter Neville. 1950. Pp. xxvi+516. 35*s.* net.

If interpolations made since the first edition be ignored, the reader may find something of interest in Parts I and II of this book, particularly the stress on resistance analysis.

Part III is curious. Dr Reich claims to have discovered the cause and cure of schizophrenia; he is certain that, in 1939, he discovered the cosmic orgone energy and that it functions in the living organism as specific biological energy. A note on the wrapper informs us that this discovery took character-analysis out of the realm of psychology and put it on the firm basis of natural science in the form of orgone biophysics. Not being a natural scientist the reviewer can concur only with the first part of this statement.

G. A. F.

OTHER PUBLICATIONS RECEIVED

MUNN, NORMAN L. *Handbook of Psychological Research on the Rat.* London: George Harrap. 1950. Pp. xxvi+598. 35*s.* net.

This book, reviewed in *The British Journal of Psychology* for December 1950, has now been published in England.

WALLIN, J. E. WALLACE. *Children with Mental and Physical Handicaps.* London: Staples Press Limited. 1950. Pp. xxii+549. 42*s.* net.

This book, reviewed in *The British Journal of Psychology* for June 1950, has now been published in England.

BUHLER, CHARLOTTE, BUHLER, KARL and LEFEVER, D. WELTY. *Development of the Basic Rorschach Score with Manual of Directions.* (Rorschach Standardization Study, I.) Los Angeles. 1948. Pp. ix+190. (Published in mimeographs by authors. No price given.)

BUMKE, OSWALD. *Gedanken über die Seele.* 1948. Vierte, durchgesehene Auflage. Pp. iii.+303. DM. 9.60 net.

CLARK, EILEEN. *A Nursery School Procedure.* New York: The Dalton Schools, Inc. 1949. Pp. 96. 75 c. net (in quantity to students: 50 c.).

COMBS, A. W., DURKIN, H. E., HUTT, M. L., MILLER, J. G., MORENO, J. L. and THORNE, F. C. *From Annals of the New York Academy of Sciences.* 1948. Vol. XLIX, pp. 867–928. $1.50 net.

COY, GENEVIEVE, L. *Ways Towards Self-discipline.* New York: The Dalton Schools, Inc. 1949. Pp. 95. 75 c. (in quantity to students: 50 c.).

CRESSON, ANDRÉ. *Le Mécanisme de l'Esprit.* Paris: Librairie Armand Colin. 1950. Pp. 220+11. 180 fr. net.

EISENBERG, PHILIP. *Why we Act as we Do.* Kingswood, Surrey: The World's Work (1913), Ltd. 1950. Pp. x+276. 10*s.* 6*d.* net.

HARRIS, NOEL G. *Modern Trends in Psychological Medicine.* Butterworth and Co. 1948. 50*s.* net.

HODGES, NORAH. *Community Service in the Dalton School.* New York: The Dalton Schools, Inc. 1949. Pp. 64. 75 c. (in quantity to students: 50 c.).

MCKINNEY, FRED. *The Psychology of Personal Adjustment.* London: Chapman and Hall. Second edition, 1949. Pp. xii+752. 36*s.* net.

NARAYANANANDA, SWAMI. *The Way to Peace, Power and Long Life.* Rishikesh, U.P., India: Prasad. 2nd ed. 1950 (1st ed. 1945). Pp. viii+190. 5*s.* including postage.

NARAYANANANDA, SWAMI. *The Primal Power in Man or The Kundalini Shakti.* Rishikesh, U.P., India: Prasad. 1950. Pp. viii+155. 8*s.* including postage.

THOMSON, G. H. *L'Analyse Factorielle des Aptitudes Humaines.* Paris: Presses Universitaires de France. 1950. Pp. 10+423. 1220 fr. net. (Translation of 'The Factorial Analysis of Human Ability'. London: University of London Press. 1949.)

WATKINS, JOHN G. *Hypnotherapy of War Neuroses.* New York: Ronald Press Company. 1949. Pp. x+386. $5.00 net.

CORRESPONDENCE

THE EDITOR,

British Journal of Psychology (General Section)

Dear Sir,

I wish to call to your attention some statistical errors in the present issue (September 1950) of the General Section. In Table 3, p. 45, of Lydia Jackson's article, numbers of subjects giving certain responses are listed. It is indicated that χ^2 has been calculated for each item and the level of significance obtained from this calculation. Unfortunately no example of the calculations are given, but from internal evidence and statements in the text, it seems that at least three methodological errors have been made.

It will be easier to identify these errors if we proceed at once to illustrate the usual way of calculating χ^2 for data such as Table 3 shows. If we take item 10, we can show the nature of the discrepancies.

	Response		
Group	Other response	Male relative or friend	Total
Normal	38 (29·08)	2 (10·92)	40
Neurotic	23 (29·08)	17 (10·92)	40
Delinquent	19 (21·81)	11 (8·19)	30
Total	80	30	110

The parenthesized numbers are the expected frequencies. $\chi^2 = 16{\cdot}01$. For 2 D.F. a χ^2 of 9·21 is significant at the 1·0% level; for 2 D.F. χ^2 of 10·60 is significant at the 0·5% level; for 2 D.F. a χ^2 of 13·82 is significant at the 0·1% level.

According to Table 3 of Jackson's article, this item is not significant at the 1·0% level. My guess is that errors committed are as follows.

(1) The text states 'that the number of responses given by the normal subjects represents the "expected" possibility, and that the numbers given by the neurotic and the delinquent subjects are the "observed" values'. Now to use the frequency of the normal subject is *not* a test of the null hypothesis that the neurotics and normals are random samples from the same universe. An adequate test of the null hypothesis demands that all hypothesized null groups be pooled together to get the best estimate of the proportion giving that response in the null universe. Karl Pearson derived the 'goodness of fit' χ^2 test on the basis of this null assumption. There is no objection to the author substituting the observed normal responses for the expected number of neurotic responses in a formula of the type

$$c = \Sigma \frac{(0-e)^2}{e}.$$

But it is clear that the distribution of c under the hypothesis that the three groups are random samples from the universe of normal subjects will not be the ordinary tabled distribution of χ^2. It will be necessary for the author to work out the distribution of c before any confident statements can be made about the observed values of c.

(2) It will be noted that item 10 is very significant by the usual χ^2 test, but is not significant at the 1% level in Table 3. I infer from this and other evidence that the author has not included the derivation of the observed non-occurrence frequencies from the expected in her calculation of c. In short, if we calculate for item 10,

$$\frac{(23-38)^2}{38} \quad \text{we must also include} \quad \frac{(2-17)^2}{17}.$$

(3) The χ^2 for any one item is correlated with the χ^2 from any other item since all were alculated from the same population. There are various dodges for testing whether the ntire set of items, taken as a whole, shows significant divergence from chance. If the uthor did not use any of these, she should have warned the reader of this fact. The same oint would arise if she had calculated *t*'s, *F* ratios, or correlations for each item.

I am not, of course, stating that these incorrect calculations necessarily invalidate the onclusions of the article. It is to be hoped that these errors do not affect the main results. ut could not the article have been checked by a statistician? Most of the errors committed y the author are easily recognized by statistics teachers as old acquaintances. Lewis and urke have pointed out that in most psychological journals, χ^2 is frequently applied ncorrectly. ('The use and misuse of the χ^2 test', *Psychol. Bull.* (1949), vol. XLVI, pp. 433–89). an we not avoid the perpetuation of these errors?

Yours truly,

ARDIE LUBIN

niversity of London,
nstitute of Psychiatry,
January, 1951

HE EDITOR,
British Journal of Psychology.

ear Sir,

It is as well to distinguish, perhaps, between statistical 'errors' in the sense of making istakes in calculations, and statistical 'liberties'. The latter, again, should be distinguished om 'abuses', in the sense of applying statistical theory inappropriately or wrongly. We lead guilty to some statistical liberties, but neither to miscalculations, nor to abuses.

It is well known, as Mr Lubin reminds us, that χ^2 is frequently applied incorrectly in sychological journals. There are occasions, however, when punctiliousness is at issue, and he theory is applied a little differently, not because it is not understood, but because therwise the circumstances of a particular experimental condition could not be repre-ented adequately.

Thus, to take Mr Lubin's first point: it seemed sensible to suppose that 'normal' subjects ould be regarded as providing a sound experimental account of what might be 'expected' heoretically. This may seem a novel bit of logic, because it does not follow the usual ext-book rules. But it is the basis of one's thinking about the situation, in which any umber of different sets of 'normal' children could be obtained very readily, and the eurotic' and the 'delinquent' groups only with difficulty. Given the hypothesis, then, that ata for the 40 'normals' is 'expected', we merely asked whether it would be reasonable o suppose that these other sets could be regarded as random samples with regard to *such* universe. If Mr Lubin wishes to examine the data from the standpoint that all possible ull groups should be pooled, we have no objection, except that it does not represent, ethodologically, what we believed to be at issue. In short, we were one step ahead of the ule-of-thumb procedure: certainly no error was committed in ignorance, but we preferred o keep this reminder in our data of the 'structured' property of our groups.

With regard to the second point raised by Mr Lubin, it is again our caution that is at sue, and not any 'mistake'. It is less arbitrary to assert what we can about *occurrences*,

and not to depend, by implication, upon 'non-occurrence' frequencies. The latter w increase the χ^2 of our significant data, as Lubin indicates for item no. 10. But we distingui statistics applied by rule-of-thumb, and their application with an eye to what they real represent: in the present case we were fully satisfied to draw attention to the fact that on 2 'normals' described 'the man outside' as 'dangerous', whereas 21 'neurotics' did s Inference about what they *didn't* say is a very different matter.

Besides, an error has crept into Mr Lubin's quotation of item 10 from Table 3. T figures 38, 23 and 19 are not 'other' (unspecified) responses. They are responses describi the 'Man outside' as 'relative or friend' and need to be considered in conjunction wi item 9: 'Man outside dangerous'. Some of the subjects described the man as a 'relativ and also as 'dangerous'.

Mr Lubin's third point is more difficult. χ^2 has its roots in independent events, an undoubtedly, contingencies may well be involved in our data. However, Mr Lubin perhaps overlooking that 'free composition' is involved for the data at issue, and n 'multiple choice' or similar test forms. Under certain conditions it is a simple matter apply tests of homogeneity to the latter. But the statistical treatment of protocols of t 'free composition' kind obviously presents a very different type of situation, and it difficult to see how the matter could be dealt with. Here again, however, we are n unaware of the issues, and perhaps solutions are possible.

Thus we would like to assure Mr Lubin that we had good reasons for the liberties we too and that it would be a pity to impute ignorance where only punctiliousness greater tha the statisticians' own is involved. The more important matter is that our conclusions we cautious and conservative ones, made under the conditions specified clearly enough in t paper.

Yours faithfully,

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